PN-ABH-164

FINAL REPORT

A CASE STUDY OF THE COMMERCIALIZATION OF AGRICULTURE IN THE SOUTHERN PHILIPPINES: THE INCOME, CONSUMPTION, AND NUTRITION EFFECTS OF A SWITCH FROM CORN TO SUGAR PRODUCTION IN BUKIDNON

by

Howarth E. Bouis
Lawrence J. Haddad

International Food Policy Research Institute
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036

in collaboration with

The Research Institute for Mindanao Culture
Xavier University
Cagayan de Oro City

March 1988

Under Grant No. OTR-0000-G-~~55~~ SS-3513-00
Submitted to U.S. Agency for International Development

The opinions and conclusions contained in this report are solely those of the researcher and do not reflect the policy or position of the U.S. Agency for International Development.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	viii
FOREWORD	x
1. SUMMARY	1
2. THE POLICY SETTING, RESEARCH DESIGN, AND CONCEPTUAL FRAMEWORK	7
Research Design and Conceptual Framework	8
Estimating Equations	12
The Philippine Policy Setting	14
The Study Area	18
Sample Selection	20
Survey Questionnaires	24
Categorizing Households for Analysis	26
3. CHANGES IN LAND TENURE PATTERNS	30
1971 and 1980 Agricultural Censuses	31
Presurvey of 2,039 Households	33
Conclusion	41
4. THE CORN PRODUCTION SYSTEM	42
Introduction	42
Past Trends in Corn Production in Southern Bukidnon	42
Corn Yields for the Survey Period 1984/85	46
Labor Inputs	48
Men, Women, and Children Labor Participation Rates	51
Fertilizer Use and Wage Rates	54
Production Function Estimations	55
Production Expenditures	56
Postharvest Disposition of Corn and Processing Costs	56
Calculation of Net Returns to Corn Production	61
5. THE SUGAR PRODUCTION SYSTEM	64
Introduction	64
Management of Sugarcane Deliveries and the Role of Producer Contracts	65
Sugar Yields by Milling Season and by Ratoon	68
Labor Inputs	71
Men, Women, and Children Participation Rates	74

TABLE OF CONTENTS
(continued)

	Page
Fertilizer Use and Wage Rates	77
Production Function Estimations	77
Production Expenditures Per Hectare	78
Total Revenues and Net Revenues Per Hectare	80
6. COMPARING CORN AND SUGAR PRODUCTION: ECONOMIC PROFITS, CHANGES IN LABOR ALLOCATION PATTERNS, OTHER SOURCES OF INCOME	86
Introduction	86
Economic Profits	87
Land Values	90
Allocation of Labor Inputs	93
Men, Women, and Children Participation Rates	98
Other Sources of Income	99
7. INCOMES, EXPENDITURES, AND CALORIE INTAKES AT THE HOUSEHOLD LEVEL	103
Introduction	103
Estimating Household Income, Expenditures, and Calorie Consumption	104
Nonfood Expenditures	106
Food Expenditures by Source	111
Estimating the Effect of Income on Food Expenditures	114
Conversion of Food Expenditures into Calorie Intakes	118
Conclusion	123
8. INDIVIDUAL CALORIE INTAKES	125
Introduction	125
Average Calorie Adequacy Ratios	126
Morbidity and Appetite	128
Estimating the Determinants of Preschooler Calorie Intakes	130
Regressions by Crop Tenancy Group	133
Conclusion	134
9. DETERMINANTS OF HEIGHTS AND WEIGHTS OF PRESCHOOL CHILDREN	137
Introduction	137
Anthropometric Data for Preschool Children and Mothers	137
Time Allocation Patterns of Mothers	142
Preschooler Morbidity Patterns	151
Household Sanitation Characteristics and Infant Feeding Practices	153

TABLE OF CONTENTS
(continued)

	Page
Nutritional Knowledge of Mothers	156
Z-score Estimations	157
Conclusion	165
10. CONCLUSIONS AND POLICY RECOMMENDATIONS	168
The Corn Production System	169
The Sugar Production System	170
Comparison of Corn and Sugar Production	172
Incomes, Expenditures, and Calorie Intakes at the Household Level	173
Intrahousehold Distribution of Calories	175
Determinants of Weights and Heights of Preschoolers	175
Methodological Considerations	177
The Broad Range of Data Which Were Collected	177
Frequency/Accuracy of Calorie Intake and Time Allocation Recall Data	180
Areas for Further Research	183
National Nutrition Policy for Agricultural Households	187
Winners and Losers	190
Development Strategy for Mindanao	192
Appendix 1 - Total Expenditures and Household Calorie Availability as Proxies for Income and Household Calorie Intakes	195
Bibliography	204

LIST OF TABLES

		Page
Table 2.1 --	List of topics covered by survey questionnaires in each round (unless otherwise specified)	25
Table 2.2 --	Selected data for respondent households, by group ..	28
Table 3.1 --	Percentage distribution of sugar and corn farms, by number of farms and by area harvested, by farm size, Bukidnon province, 1971 and 1980	32
Table 3.2 --	Present primary occupation of heads of households, all barangays	35
Table 3.3 --	Present primary occupations of heads of households by municipalities close to and far away from the mill	36
Table 3.4 --	Households presently involved in sugar production by type of land tenure, by previous occupation and type of land tenure, and by municipalities close to and far away from BUSCO	38
Table 3.5 --	Percentage distribution of number of landowning corn and sugar producers by size of holding, by municipalities close to and far away from BUSCO, and by present and previous holdings	39
Table 4.1 --	Comparison of past and present corn yields, by crop and tenure groups, by large and small farms ...	44
Table 4.2 --	Trend in share of harvest paid to corn laborers	45
Table 4.3 --	Total labor inputs (input days) per hectare per corn crop, by family and hired labor crop and tenure group, and by large and small farms	49
Table 4.4 --	Total labor days per hectare per corn crop, by task, by crop and tenure group, and by large and small farms	50
Table 4.5 --	Total labor inputs per hectare per corn crop by family and hired labor by men, women, and children	52
Table 4.6 --	Women and children participation rates for various tasks in corn production by family and hired labor, all households	53
Table 4.7 --	Total expenditures per hectare per corn crop by cash and in-kind wages and by cash paid for nonlabor inputs, by crop and tenure groups, and by farm size	57
Table 4.8 --	Per capita production and consumption out of own production (kgs. shelled corn per week), by crop and tenure group, by farm size	58
Table 4.9 --	Total revenues and net revenues per hectare per corn crop by crop and tenure group, and by farm size	62
Table 5.1 --	Sugar yields by crop and tenure group and by milling season, and by ratoon number (metric tons of cane per hectare)	69

LIST OF TABLES
(continued)

		Page
Table 5.2 --	Total labor inputs per hectare per sugar crop, by family and hired labor and by group	72
Table 5.3 --	Total labor inputs per hectare per sugar crop, by task and by tenure group	73
Table 5.4 --	Total labor inputs per sugar crop by family and hired labor, by men, women, and children	75
Table 5.5 --	Women and children participation rates for various tasks in sugar production by family and hired labor, all households	76
Table 5.6 --	Total expenditures per hectare per sugar crop by cash and in-kind wages, and by cash paid for nonlabor inputs, by group (all ratoons)	79
Table 5.7 --	Total expenditures per sugar crop (cash plus in-kind) by plant and ratoon crops, by tenure group	81
Table 5.8 --	Total revenues and net revenues per hectare per sugar crop, by group, 1983/84 milling season	83
Table 5.9 --	Total revenues and net revenues per hectare per sugar crop, by group, 1984/85 milling season	84
Table 6.1 --	Corn production profits per hectare per crop, by group	88
Table 6.2 --	Sugar production profits per hectare per crop, by group	89
Table 6.3 --	Labor inputs for corn and sugar, by family and hired labor, and by participation rates of men, women, and children, total sample	94
Table 6.4 --	Family days and hired labor per hectare for corn and sugar production for selected tasks, sample average	95
Table 6.5 --	Family days and hired labor days for weeding by hand for corn and sugar production, by selected crop and tenure group, by size of farm	97
Table 6.6 --	Percent allocation of income by income quintile and by crop tenancy group	101
Table 7.1 --	Per capita income, total expenditures, food expenditures, food budget shares and per adult equivalent calorie availability and intakes by income group, expenditure group and by crop-tenancy group (1984 pesos per week per capita; calories per day)	107
Table 7.2 --	Weekly per capita nonfood group expenditures and shares of total expenditure by per capita total expenditure quintile, all rounds (Round 1 - constant pesos)	108
Table 7.3 --	Nonfood expenditures for selected categories by expenditure quintile by crop-tenancy group	110

LIST OF TABLES
(continued)

		Page
Table 7.4 --	Percent allocation of weekly per capita food expenditures by source by expenditure quintile and by crop tenancy group	112
Table 7.5 --	Per capita corn and rice expenditures by source by crop and tenancy group	113
Table 7.6 --	Regression results where the dependent variable is food expenditures per capita per week	116
Table 7.7 --	Calories purchased per peso, by crop tenancy group by total expenditure quintile, all rounds	119
Table 7.8 --	Percent allocation of weekly per capita food expenditures by broad food group by income quintile by crop tenancy group	120
Table 7.9 --	Regression results where the dependent variable is household calorie intake per adult equivalent per day	122
Table 8.1 --	Average calorie adequacy ratio and percent falling below 80 percent of caloric requirements by type of family member by expenditure quintile and by crop tenancy group	127
Table 8.2 --	Preschooler calorie intakes by whether preschooler was sick with any symptom in the past two weeks, by whether had a fever, and by whether had diarrhea	129
Table 8.3 --	Regression results where the dependent variable is preschooler calorie intake per adult equivalent per day	131
Table 8.4 --	Selected coefficients for preschooler calorie intake regressions run separately for each crop tenancy group	135
Table 9.1 --	Height-for-age, weight-for-age, and weight-for-length by age and expenditure quintile for preschool children	139
Table 9.2 --	Height-for-age (ZHA) by crop-tenancy group by age tercile for children for whom breastfeeding has been stopped	141
Table 9.3 --	Mother's weight and height by expenditure quintile and by crop and tenure group	143
Table 9.4 --	Percentage allocation of mother's time, net of personal care time, by expenditure quintile, and by crop tenancy group	145
Table 9.5 --	Minutes spent by mother in childcare and in fieldwork by currently breastfeeding mothers and by mothers who have stopped breastfeeding	146

LIST OF TABLES
(continued)

Page

Table 9.6 -- Time spent by mothers away from the house by own-farm and off-farm activities by currently breastfeeding mothers and mothers who have stopped breastfeeding by crop tenancy group 149
Table 9.7 -- Prevalence of sickness, fever, and diarrhea by currently breastfeeding children and children who have stopped breastfeeding, by expenditure quintile and by crop-tenancy group 152
Table 9.8 -- Sanitation characteristics by expenditure quintile and by crop-tenancy group 154
Table 9.9 -- Infant feeding practices by expenditure quintile and by crop and tenure group 155
Table 9.10-- Regression results where the dependent variable is weight-for-length (ZWL) 158
Table 9.11-- Regression results where the dependent variable is height-for-age (ZHA) 159
Table 9.12-- Summary of selected coefficients for ZHA regressions disaggregated by age tercile and by crop group 163

APPENDIX TABLE

Table A.1 -- Income elasticities of household calorie consumption implied by two-way relationship shown in Table 7.1 200

LIST OF FIGURES

Figure 2.1--Household resource allocation and nutrition 10
Figure 2.2--Map of the Philippines indicating study area 19
Figure 2.3--Location of survey barrios relative to BUSCO, Southern Bukidnon Province survey area 22
Figure 4.1--Seasonal cropping pattern for corn production 47
Figure 5.1--Seasonal cropping pattern for sugar production 70

ACKNOWLEDGMENTS

This report has been many years in the making, and there are several people whom we would like to acknowledge, who gave more of themselves than we could have reasonably expected and without whom this report would not have been possible.

We would like to thank all the staff at the Research Institute for Mindanao Culture for the wonderful job that they did, especially the supervisors under the direction of Lourdes Wong. The project was literally in their hands for a year and a half and we learned a lot from them on how a survey should be run. Our most important lesson is never again to attempt such a long and difficult questionnaire, but they pulled it off as the report will show. We would like to express our indebtedness to Father Francis Madigan for putting together such a professional staff over so many years of dedicated work at RIMCU.

We would like to express our gratitude 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. Susie's competence and enthusiasm for her work helped us get through some difficult times when the scope of what we were trying to collect seemed a bit overwhelming.

We would like to thank Joel Asentista, head of the Xavier extension program in Bukidnon, for giving up so much of his personal time to

familiarize us with the study area, simply because he felt our research was worthwhile.

We would like to thank Roberto Montalvan, president of the Bukidnon Sugar Planters Association, also for giving up so much time out of his busy schedule to explain how operation of the sugar production and milling system worked, and for the opportunity to speak before the Planters Association to explain the objectives of our study.

We would like to thank Father Antonio Ledesma and the graduate students of the Institute for Market Analysis who worked with us primarily on Phases I and III. Separate papers for those parts of the overall project acknowledge their efforts more fully, but their background knowledge of the area, not to mention logistical support, were essential inputs into Phase II as well.

Finally, we would like to thank the United States Agency for International Development not only for the opportunity and freedom to undertake research, which we think is very worthwhile, by funding the project, but also for being so understanding about the delays that occurred. We hope the end product is worth the wait.

FOREWORD

This report is one of three documents prepared under grant number OTR-0000-G-55-3513-00. It constitutes Phase II of the Philippine Cash Cropping Project and is the main focus of the research. It analyzes four rounds of data taken from surveys of approximately 500 households at four-month intervals during 1984 and 1985. The data were collected by the Research Institute for Mindanao Culture (RIMCU) at Xavier University, Cagayan de Oro City, under the direction of Father Francis Madigan, under a subcontract with IFPRI. RIMCU is in no way responsible for the views expressed in this report.

Phase I of the project consists of detailed case studies of ten households in Southern Bukidnon. Phase III provides an economic overview of the rapid expansion of export crop production in Mindanao as a whole over the past fifteen years, and the economic and political factors that have led to this expansion. Phases I and III were undertaken in collaboration with the Institute for Market Analysis at Xavier University, under the direction of Father Antonio Ledesma.

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 that were used to produce agricultural exports had been used instead to produce food for the local economy, then 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 to look at the process of agricultural commercialization in five specific country contexts. This research report presents the findings for the Philippine case study.

Philippine policymakers are under pressure to increase agricultural exports because of an enormous foreign debt. In the past, sugar and coconuts have provided the bulk of foreign exchange earnings from agriculture, but because future world demand for these products is not perceived to be strong and because of a desire to diversify its agricultural export base, attention has focused on what are referred to as the "nontraditional" export crops (e.g., bananas, cacao, rubber, palm oil, coffee). Much of the expansion of nontraditional export crop production over the past decade has taken place on the southern

island of Mindanao, where corn has traditionally been the predominant crop and an important staple of low-income groups.

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 semi-subsistence corn production, before establishment of a sugar mill in 1977. Data were collected on landholdings, income sources, expenditure patterns, calorie intakes, and nutritional status. Analysis of these data provides a detailed, household- and individual-level look at what happened to land tenure patterns, incomes, and nutrition in one case study area in undertaking an export-led development strategy.

An initial random sample of households both far away from the sugar mill (households which 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 land. When households engaged in sugar production were asked to characterize their tenancy status before introduction of sugar seven years earlier, the pattern of distribution that emerged between owner, share tenant, and landless laborer households was very similar to that presently existing for corn households. Several former corn tenant households had lost access to their land when landlords, who had decided to grow sugarcane, chose to

hire in labor with the new crop, rather than to 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 (U.S. $225 per hectare per year for sugar as compared with $100 per hectare per year 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 were presently about half of what they were when they first settled their land, due to declining soil fertility. Despite this, almost 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 of the labor is hired in. These fractions between family and hired labor are reversed for sugar production. Women contributed 23 percent of the total labor going into corn production, but only 11 percent of the total labor going into sugar production. On average, women contributed 12 days of family labor per hectare per year in corn production, but only 3 days of family labor per hectare per year in sugar production.

Sugar households had higher incomes on average than corn households, partly due to higher profits from sugar and partly due to larger landholdings, although 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 0.42, 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 less than a 10 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 breast-feeding had been stopped) at all income levels consumed well below their recommended calorie intakes. Regression results imply greater competition for scarce calories between parents and preschoolers at low-income levels.

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 children three and four years of age, which means that height-for-age deteriorates 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. Dividing preschoolers (for whom breastfeeding has been stopped) from households with access to land (landowner and tenant/renter groups) into age terciles, sugar household children in the youngest age tercile are significantly taller than corn household children. However, corn household children in the oldest age tercile are slightly taller than

sugar household children, although the difference is not statistically significant.

During breastfeeding, sugar household wives spend more time in childcare, less time doing fieldwork, and less time away from home than corn household wives (comparing only households with access to land). Once breastfeeding is terminated, sugar household wives spend more time away from the house, less time in childcare, and about the same amount of time in fieldwork as corn household wives. Such a dichotomy in time allocation patterns is consistent with the reduced responsibilities of sugar household wives in farm production, and with the more rapid deterioration in height-for-age for sugar household children once breastfeeding is stopped.

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

Preschool children in the oldest age tercile 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.

Export cropping can significantly raise the incomes of smallholder producers. However, to prevent a further deterioration in land

distribution patterns, the government needs first to make a conscious effort to develop the inevitable expansion of export cropping on a smallholder basis by providing smallholders 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, raising household incomes appears to be a necessary but not a sufficient condition for improving 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 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 improving community-level health and sanitary conditions.

2. THE POLICY SETTING, RESEARCH DESIGN, AND CONCEPTUAL FRAMEWORK

In many less developed countries, vast amounts of land and other inputs are devoted to production of agricultural commodities for export. Production of these exports, whether staple or nonstaple foods or inputs for manufacture, whether sent abroad or to other regions of the same country, often coexists with significant malnutrition. Might not the resources that were used to produce these exports have been used instead to produce food for the local economy to reduce, or even to eliminate, the problem of malnutrition?

Many economists would argue that the process of commercialization, by raising incomes, actually improves a nutritional situation which might have been worse otherwise. Specialization, the 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? Could a different approach to agricultural development, one of regional, or village, or even household food self-sufficiency, better alleviate the particular problem of malnutrition and still meet the objectives of economic growth and higher incomes?

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 implementing future projects and policies, then, our goal would be for policymakers to find ways to enhance the beneficial factors, while minimizing the harmful ones.

Toward this end, IFPRI has conducted micro-level studies in five countries--The Gambia, Guatemala, Kenya, the Philippines, and Rwanda--in rural areas in which farm households have recently undergone a switch from semisubsistence staple food production to production of crops primarily for sale in the market. This monograph reports 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.

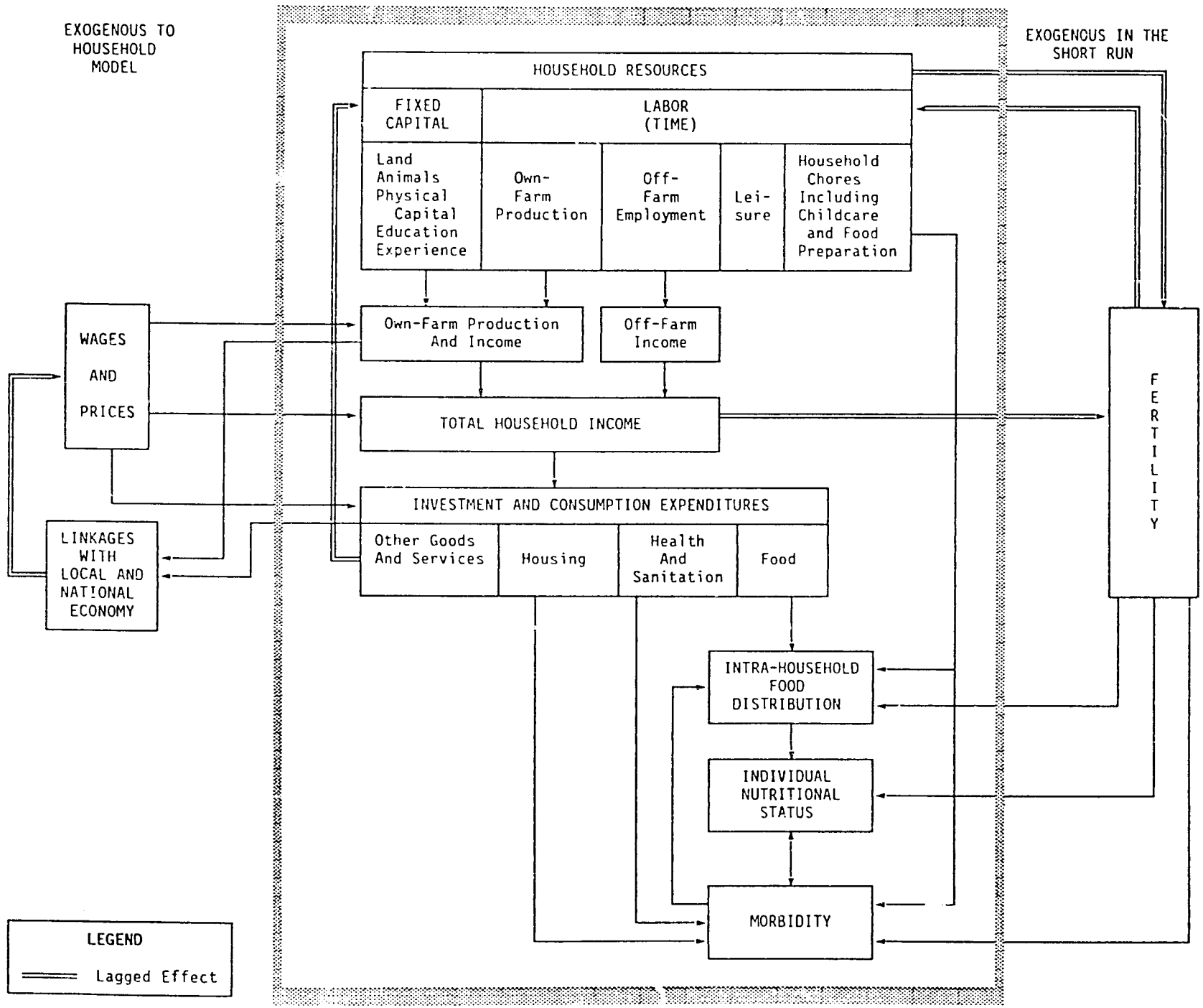
RESEARCH DESIGN AND CONCEPTUAL FRAMEWORK

After reviewing 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 (see Bouis et al. 1984). First, it was clear that the optimal strategy would consist in surveying semisubsistence households before and at several intervals after the introduction of a new cash crop. The practical considerations of identifying an area which 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 could be followed of cross-sectional comparisons of two groups, one that had switched to cash cropping and another group which had remained in semisubsistence food production, if care was taken to choose two groups as similar as possible in terms of resource bases and other factors which 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 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, 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 (shown in Figure 2.1), before proceeding to collect data for various components of this framework.

Figure 2.1--Household rescurce allocation and nutrition



The theoretical underpinnings for the intuitive diagram in Figure 2.1 are provided by the literature on the new household economics (see Singh, Squire, and Strauss 1986, for a general treatment of agricultural household modelling, and Pitt and Rosenzweig 1985, for an application that focuses on nutritional outcomes). 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 utility from 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 which can then be spent on various consumption items. Because we are especially interested here in nutritional outcomes, we will focus 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 2.1, 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 affect nutrition. Morbidity is an important determinant of appetite and of how well nutrients are absorbed by the body. The household that earns less income because it allocated more time to food preparation and childcare could, conceiv-

ably at least, enjoy better nutrition because of reduced morbidity, than if it had earned the 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. Our research strategy, then, is to collect detailed household- and individual-level information on income, production, consumption, time allocation, morbidity, and nutritional status for cash crop adopting and non-adopting 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.

ESTIMATING EQUATIONS

In order to test for differences in allocation behavior across groups, it will of course be necessary to represent the links between production and nutrition, identified in Figure 2.1, as equations which may be estimated from the data to be collected. In household modeling, the usual practice is to treat all allocation decisions (e.g., what to produce, what to consume) as simultaneous decisions. Econometrically, this leads to a set of reduced-form equations with endogenous outcomes as dependent variables (e.g., household food demand, nutritional status of individuals) and exogenous variables such as prices as explanatory variables. In terms of their value for policy analysis, what the estimated equations provide is measure of the *net* effect of a change in, say, a staple food price on a policy objective,

for example, nutritional status, which is the sum of positive and negative effects at various links in the overall system. Unfortunately, because it is not possible to identify the structural coefficients from these reduced-form estimations, it is not possible to draw any conclusion as to the specific impact of crucial variables in the system at each particular link (e.g., the impacts of individual calorie intakes and morbidity on nutritional status). 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, the household decisionmaking process is not simultaneous, 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 (see Hausman 1978). If the null hypothesis of exogeneity fails, then two-stage least squares may be used to estimate that equation which should give unbiased estimates.

(1) FOOD EXPENDITURES = f_1(INCOME, Prices, Demographics, Mother's Education, Father's Education)

(2) HOUSEHOLD CALORIES = f_2(FOOD EXPENDITURES, Prices, Demographics, Mother's Education, Father's Education)

(3) PRESCHOOLER CALORIES = f_3(HOUSEHOLD CALORIES, Demographics, Education, Father's Calories, Mother's Calories)

(4) PRESCHOOLER NUTRITION = f_4(PRESCHOOLER CALORIES, MORBIDITY, Demographics, Education, Child Care, Father's Height, Mother's Height)

The above formulation is meant to be general. Particular variables to be used in each equation will be discussed more specifically later when the regression estimations are presented.

THE PHILIPPINE POLICY SETTING

While the initial impetus for undertaking the five IFPRI case studies was for the purpose of making cross-country comparisons so as to draw possible generalizations about the process of commercialization and its effects on nutrition, an equally important objective is to provide analysis of policy questions that are relevant to the concerns of government officials in the particular country where each of the individual studies was undertaken. In the Philippines the economic crisis, precipitated in October of 1983 by the government's inability 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 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. These issues address the problems of agriculture in a general way, focusing attention on some very necessary conditions for efficient allocation of private sector resources. There has been broad consensus on the necessary corrective measures, and some policies have already been put in place to rectify mistakes of the past.

Public attention with respect to agriculture shifted dramatically to the issue of land reform in January of 1987, when several farmers who were demonstrating for land reform near Malacanang Palace were killed by security forces. 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 for 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 for getting government out of agriculture after the experience of the Marcos years, perhaps because the 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 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 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 the more widely grown than rice. Mindanao has also witnessed a rapid expansion of nontraditional export crop production, 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 rice and corn production, which typically has been undertaken on smaller operational units and which may need to be imported in larger and larger quantities in the years ahead (see Bouis 1988).

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 an agricultural sector model which could determine aggregate supply and demand reponses 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 three million hectares of corn are harvested each year, about the same area harvested as rice. Yet its 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.

THE STUDY AREA

Southern Bukidnon lies about midway between the two principal cities in Mindanao--Cagayan de Oro on the northern coast, and Davao City on the southern coast (see Figure 2.2). The study area is about a five-hour bus ride from Cagayan de Oro on a partially cemented road which 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. Some areas are flat and suitable for irrigation which is available from the Pulangi River which begins in the mountains of Northern Bukidnon and empties into the broad flatlands of Cotabato to the south. Other areas are gently sloping and/or hilly. Although smallholder farms are larger than average for the Philippines, population pressure is already apparent from cultivation which is taking place on hilly slopes.

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. Corn exports flow north to Cagayan de Oro and thence to the heavy corn-eating areas of the Central Visayas.

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.

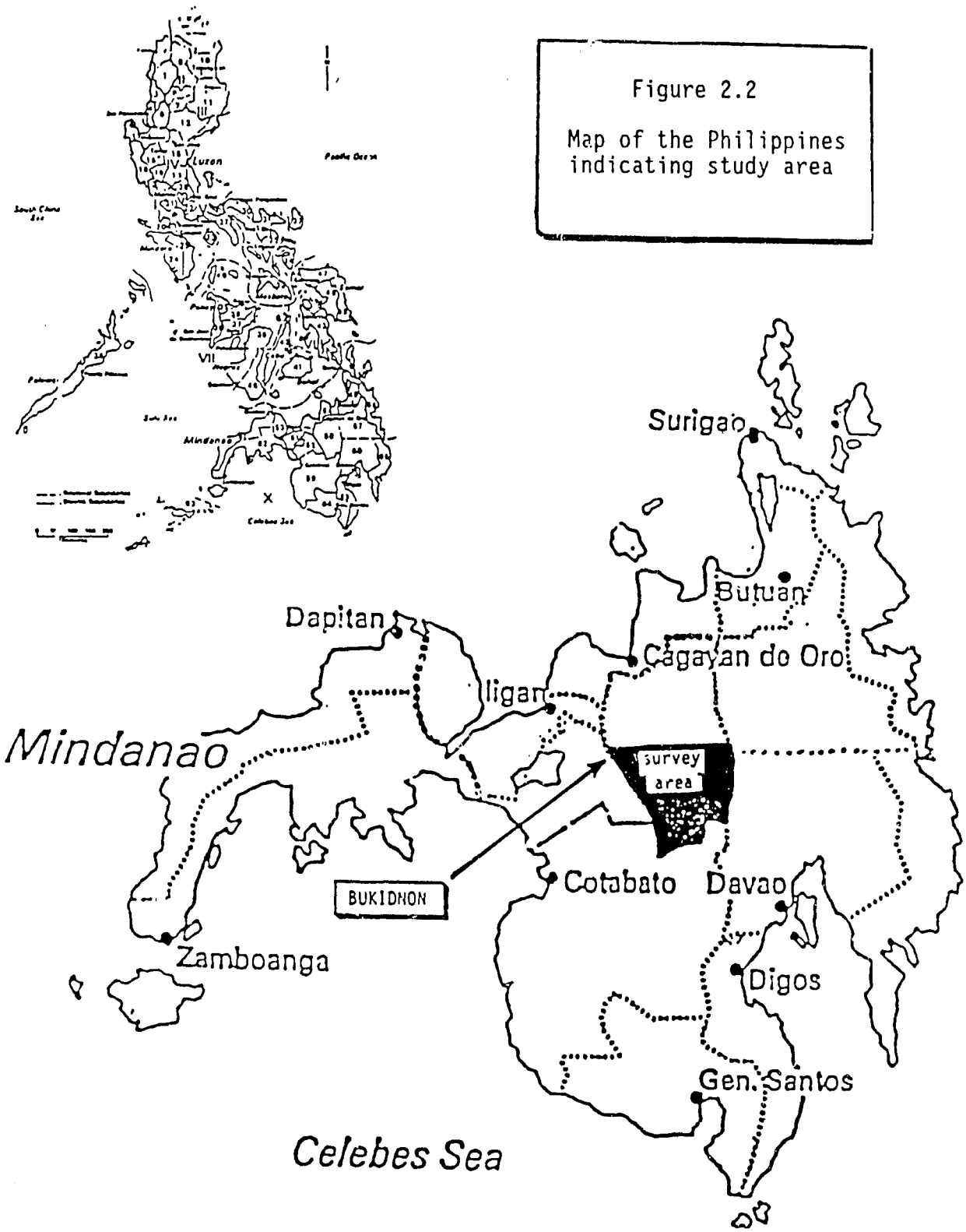


Figure 2.2

Map of the Philippines indicating study area

Contracts for as little as one and two hectares were given out. The number of members of the Sugar Planters Association is now nearly 2,000, dominated by smallholders in terms of absolute members but not in terms of 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.

The contract calls for the grower to plant a specified number of hectares to sugar for a period of five years. After five years, the mill at its own discretion may cancel the contract or bind the grower to continue to produce for an additional five years. The prices to be paid to the sugar growers are not stipulated in the contract. During the survey period, all mills in the Philippines were by law obligated to sell their sugar to NASUTRA, the government sugar trading agency. The price that was received during the survey was a weighted average of three prices: (a) sugar exported to the United States under a quota arrangement whose price was well above the international price, (b) sugar consumed domestically whose price was also above the international price, and (c) sugar sold on the international market, whose price was extremely low.

SAMPLE SELECTION

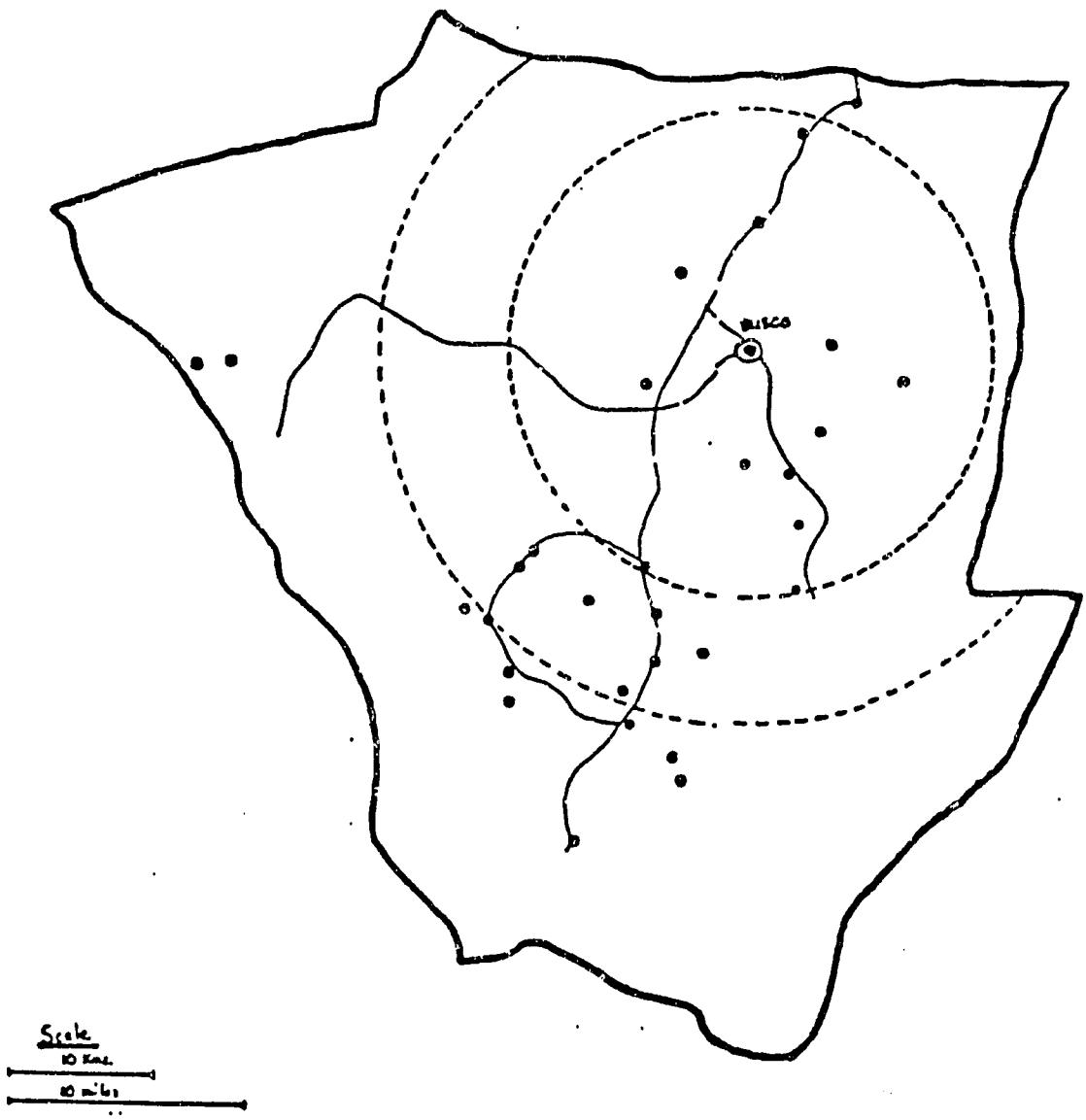
While conceptually the common research strategy is simply to sample cash crop adopting (sugar households) and non-adopting households (corn households), in the Philippine context the situations of landowners, tenants, and landless laborers need to be compared and

contrasted, both within and across crop groups. This complicates the sample selection process.

For the detailed household surveys, a decision was reached to choose 17 households in each of 30 barrios (barrios ranged in size from roughly 100 to 1,000 households) to give a total sample of 510 households. From informal interviews, it was clear that distance from the mill was a main determinant of the profitability of sugar production and its prevalence in a particular barrio. The survey area was extended to include households that did not have the opportunity to adopt sugar simply because their farms were too far away from the mill, but that shared a common growing environment and cultural heritage with sugar-adopting households, in the hope of obtaining roughly comparable adopting and non-adopting groups, while minimizing the problem of bias due to adopter self-selection. Three lists for the selection of the 30 barangays were drawn up: (1) barrios close to the mill (sugar production common), (2) barrios at an intermediate distance (sugar production sparse), and (3) barrios far away from the mill (sugar production nonexistent or rare).

Ten barrios were selected from each list at random, but with the probability of selection being proportionate to the number of households in that barrio (see Figure 2.3). In each of the 30 barrios selected, a short questionnaire was administered to 68 households selected at random. This presurvey, which asked primarily about present and previous occupations, crops being grown, and landholdings, served two purposes. First, it gave a picture of present employment and land tenure patterns in the survey area and how these patterns had

Figure 2.3--Location of survey barrios relative to BUSCO, Southern Bukidnon Province survey area



changed since the sugar mill had been built. These findings are reported in the following chapter. Second, it provided a frame for choosing a sample of 510 households consisting of landowner, tenant, and landless labor households within each crop group.

Only households with at least one child less than 60 months of age that farmed less than 15 hectares were eligible for selection. Likewise, only households that characterized the primary occupation of the head of household as being employed in either corn or sugar production (including wage income) were eligible for selection, except for a small target group of households that indicated that although the head of household received income from either sugar or corn production, this was not their primary source of income. Later analysis of the detailed survey data indicated that the respondent characterizations of themselves as either landowner, tenant, or landless labor households, primarily engaged either in corn or sugar production, 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. 448 households remained by the end of round four. Outmigration was the primary cause for the reduced number of observations, which consisted for the most part of landless or nearly-landless households. Only one household refused to cooperate after participating in round one.

SURVEY QUESTIONNAIRES

Table 2.1 shows the topics covered in each of the four survey rounds. The time of interview per respondent household averaged about three hours, divided into two visits. During the first visit, all household members were weighed and their heights taken. In addition, blocks A, M, P, T, and U (see Table 2.1) were administered to the wife, which covered such areas as food expenditures, a 24-hour recall of individual food intakes, recent morbidity, and feeding practices for preschoolers. This interview lasted anywhere from 75 to 105 minutes, depending on the variety of foods purchased and eaten, not counting the time for weighing and measuring heights. The first visit dealt exclusively with food and nutrition measures, to emphasize to the respondents that nutrition was the main focus of the research. The second interview dealt with the more sensitive questions regarding the household's income.

Administration of the survey instrument was divided into two visits to prevent respondent fatigue as much as possible. The second interview lasted an average of 90 minutes, about equally divided between husband and wife. The husband's interview consisted of blocks B through L, which dealt primarily with asset ownership, farm production information, and other income-generating activities. The wife was asked to sit in on this interview if she did not have other pressing duties, as she could often help with several of the answers. The wife was asked blocks N, O, Q, R, and S, dealing with nonfood expenditures, food preparation, sanitation and health facilities, reproductive history, and a recall of her activities in the past 24 hours.

Table 2.1--List of topics covered by survey questionnaires in each round (unless otherwise specified)

Block	Topics	Explanation
A*	General Household Information	Demographics, Education, Migration
B	Parcels of Land	Ownership, Tenure Relations
C	Agricultural Production Record	Steps In Production, Output
D	Sugar Producer's Questionnaire	} Post-Harvest Processing,
E	Corn Producer's Questionnaire	} Disposition of Output Including
F	Rice Producer's Questionnaire	} Revenues 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	Non-Agricultural Employment and Transfers
J	Backyard Production	Livestock, Fruits, Vegetables
K	Assets (Round 1 and 4)	
L	Past Income and Assets (Rounds 1 and 4)	
M*	Food Expenditures	One-Month Recall
N	Nonfood Expenditures	Four-Month Recall
O	Source of Water/Food Preparation (Round 1)	
P*	Preschool Feeding Practices (Round 2)	
Q	Reproductive History (Round 1)	
R	Health Services/Nutritional Knowledge	
S	Time Allocation of Wife	24-Hour Recall
T*	Anthropometry and Morbidity	2-Week Recall
U*	Individual Food Intake	24-Hour Recall
V	Perceptions of and Reactions to Technological Change (Round 4)	

* Accomplished on first visit to households. Remaining blocks covered during a second visit.

CATEGORIZING HOUSEHOLDS FOR ANALYSIS

For purposes of analysis, households were divided into ten groups. Any household cultivating an average of at least one hectare per round of any crop which 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 one hectare per round were placed in one of four groups, "corn owner", "corn owner/tenant (mixed)", "corn tenant", and "corn other rent", depending on the proportion of total land cultivated which was owned, rented in on 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 one 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 were greater than agricultural wages from all other crops, households were designated as "sugar laborer". The remaining "corn laborer" households had sugar wages which were less than half of total agricultural wages.

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 which were found. Virtually all "sugar" households produced some corn, except for sugar laborer households which had no land at all.

Table 2.2 presents selected characteristics which can be compared across the ten household groupings. The data show that our 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 comparing tenant/renter households with landless households, and although the data are not shown in Table 2.2, comparing large farms with small farms. The level of education is low, with respondents just having finished grade school on average.

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 ₱20 for each U.S. $1, per capita incomes of landless laborer households are roughly $80 per annum, those of corn owner households about $130, and those of sugar owner households approximately $195. While owner households will be referred to repeatedly throughout the text as high-income households, which they are relative to the landless laborer households, it is well to keep in mind that these are not high incomes in any absolute sense.

Table 2.2--Selected data for respondent households, by group

Group	No. of Households	Age		Percent Born In Bukidnon		Years Ago Migrant To Bukidnon		Years Of Education		Years Married	Household Size	Ave. Has. Cultivated Per Round	Per Capita Weekly Expenditure	Per Capita Weekly Income	Per Capita Average Net Worth
		Husband	Wife	Husband	Wife	Husband	Wife	Husband	Wife						
Corn-owners	46	41.4	36.8	0.07	0.13	26	22	6.5	7.0	17	7.7	3.3	46.1	51.7	30,589
Corn-owners/ share tenants	44	38.0	34.0	0.11	0.07	25	20	5.8	6.2	15	7.4	3.7	45.0	50.2	18,698
Corn-share tenants	91	34.7	31.3	0.14	0.22	22	19	5.6	6.2	12	6.4	2.0	39.9	30.7	9,744
Corn-laborers	51	33.1	30.0	0.12	0.27	18	17	4.5	5.2	9	5.7	0.3	33.2	28.8	2,135
Sugar-owners	41	44.6	38.9	0.02	0.07	26	25	5.3	6.3	20	9.0	6.3	62.1	75.9	62,656
Sugar-owners/ renters	30	37.4	34.0	0.10	0.03	22	22	6.6	6.8	14	7.1	7.6	85.9	90.3	87,932
Sugar-renters	31	37.0	32.3	0.06	0.06	21	20	6.0	6.6	14	7.3	3.0	43.5	46.5	13,079
Sugar-laborers	54	32.8	30.2	0.06	0.20	17	18	4.7	5.2	11	6.2	0.2	33.0	28.7	2,201
Corn-other rent	18	34.5	30.6	0.17	0.28	22	20	6.4	7.3	12	5.7	1.9	46.1	38.1	13,324
Other occupation	42	35.6	31.9	0.10	0.26	18	19	6.8	7.2	11	6.0	0.3	43.8	42.9	7,975
Total Sample	448	36.6	32.8	0.10	0.17	21	20	5.7	6.3	13	6.8	2.6	45.4	44.9	21,371

Comparing like tenure groups across crops, while 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 higher 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, as will be seen in Chapter 9, sugar household children are not taller and do not weigh more than corn household children once they reach the ages of three and four. This difference in resource bases only reinforces a final conclusion that, while higher incomes may be a necessary condition for improving nutritional status of preschoolers, it is not a sufficient condition.

3. CHANGES IN LAND TENURE PATTERNS

Referring back to the intuitive household model presented in Figure 2.1 in Chapter 2, several variables are treated as exogenous in this study, most importantly prices and the fixed factor inputs available to the household for agricultural production, in particular land. Such assumptions are appropriate for analyzing household data collected over a period of one or two cropping cycles, and are a useful device for understanding the household decisionmaking process. In formulating policies, however, government decisionmakers are forced to consider how their actions will affect prices and the distribution of the factors of production, which are endogenous to their decisions, even in the short run when large numbers of households react quickly and in the same way to a particular policy stimulus.

The effect of changing prices, including wages, due to the introduction of export cropping, as has already been mentioned, is primarily an issue at the national aggregate level and is left to simulation of an agricultural sector model, which is beyond the scope of the research reported here (see Bouis 1987, for simulation of such a model). At the local level, Bukidnon has remained a net exporter of corn, the main staple food there, in a country where cereal markets operate efficiently (see Bouis 1983). Total labor inputs per hectare per year for corn and sugar in the study area are nearly identical (as will be discussed in Chapter 6). Sugar production occupies less than

ten percent of the total cropped area in Bukidnon (one of 17 provinces in Mindanao; see Figure 2.2), and labor mobility is high, as evidenced by high rates of migration. It is therefore unlikely that the introduction of sugar had much of an effect at all in the survey area on the price of corn, or the wage paid to labor.

The introduction of sugar, however, has apparently led to a very serious deterioration in the distribution of access to land. This is an unfortunate result for at least two reasons. First, of course, 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), this skews income distribution, and actually worsens the plight of low-income groups. 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, and Mellor 1976).

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 two sources, two agricultural censuses conducted by the National Census and Statistics Office in 1971 and 1980, and the presurvey (already mentioned in Chapter 2) of a random sample of 2,039 households in the study area in 1984. Table 3.1 shows the distribution of sugar

Table 3.1--Percentage distribution of sugar and corn farms, by number of farms and by area harvested, by farm size, Bukidnon province, 1971 and 1980

Crop/ Year	Size of Farm: Less Than 1.00 Ha.	1.00 to 3.99 Ha.	3.00 to 4.99 Ha.	5.00 to 10.00 Ha.	10.00 to 24.99 Ha.	25.00 Ha.	Total Percent	Total Absolute Number
				(number of 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
				(area harvested)				
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

Source: 1971 and 1980 Agricultural Censuses, National Census and Statistics Office, Manila.

and corn farms by number of farms and by area harvested, by size of farm, for 1971 and 1980 for the whole of Bukidnon province. In 1971 sugar production was negligible, but had expanded to over 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, Table 3.1 shows that corn is a smallholder crop. In 1971 nearly three-fourths of corn farms were less than five hectares in size and accounted for 40 percent of all corn area. Between 1971 and 1980, corn area harvested increased by 68 percent and the number of corn farms by 51 percent, implying (assuming no change in the cropping intensity) a modest reduction in average corn farm size and a rapid expansion of population consistent with the migration data shown in Table 2.2. By 1980 nearly 50 percent of corn area was on farms of less than five hectares.

While these figures strongly suggest that sugar expansion came at the expense of smallholder production, there was apparently some expansion of total cropped area onto previously unused land during the 1970s, operational farms are not disaggregated by type of tenure, and the data cover the entire province of Bukinon only up to 1980 before the expansion of the sugar mill's capacity. The presurvey of 1984 offers more precise evidence on this issue.

PRESURVEY OF 2,039 HOUSEHOLDS

A 10-to-15 minute questionnaire was administered to 2,039 randomly selected households in April of 1984, covering the main occupation of

the head of household, secondary sources of income, crops produced, and basic demographic information. Table 3.2 presents the distribution of primary occupations of the heads of household recorded from this survey. Eighty percent of the respondents identified themselves as either landowners, tenants, or agricultural laborers. Three-fourths of these respondents directly employed in agriculture were engaged in corn production, while only seven percent were employed in sugar production.

Table 3.3 subdivides the sample into two groups: those respondents from the three municipalities closest to the sugarcane mill and those from the remaining seven municipalities. As expected, sugar employment is five times as prevalent in the three municipalities closest to the mill. However, even in those municipalities, sugar production was the primary occupation for less than 20 percent of farming respondents compared with 70 percent for corn.

More importantly, comparing the tenure patterns between corn, rice, and sugar production, corn and rice laborer households account for a very small fraction of all households engaged in cereal production, with the number of landowners and tenants about equal. In contrast for sugar, laborers account for half of the households, with a much lower percentage frequency for tenants and a somewhat lower percentage frequency for landowners, as compared with corn. 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 3.2--Present primary occupation of heads of households, all barangays

Occupation	Frequency	Percent of All Respondent	Percent of Total for Each Particular Crop
Corn			
Total	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			
Total	116	5.7	100.0
Landowner	44	2.3	37.9
Tenant	16	0.8	13.8
Laborer	56	2.7	48.3
Rice			
Total	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			
Total	59	2.9	100.0
Landowner	38	1.9	64.4
Tenant	8	0.4	13.6
Laborer	13	0.6	22.0
Total direct agricultural employment	1,627	79.8	
Transportation-related jobs	94	4.6	
Skilled workers	62	3.0	
Small business/trading	76	3.7	
Others (professional, executives, police, technicians, services, typists, clerks, jobless)	134	6.6	
Total	2,039	100.0	

Table 3.3--Present primary occupations of heads of households by municipalities close to and far away from the mill[a]

Occupation	Three Municipalities Closest to BUSCO			Seven Municipalities Farthest from BUSCO		
	Frequency	Percent of All Respondents	Percent of Total for Each Particular Crop	Frequency	Percent of All Respondents	Percent of Total for Each Particular Crop
Corn						
Total	300	69.8	100.0	933	82.1	100.0
Landowner	158	36.7	52.7	486	42.7	52.1
Tenant	135	31.3	45.0	416	36.6	44.6
Laborer	7	1.6	2.3	31	2.7	3.3
Sugar						
Total	73	17.0	100.0	37	3.3	100.0
Landowner	30	6.7	41.1	12	1.1	32.4
Tenant	13	3.0	17.8	3	0.3	8.1
Laborer	30	7.0	41.1	22	1.9	59.5
Rice						
Total	47	10.9	100.0	119	10.5	100.0
Landowner	18	4.2	38.3	71	6.2	59.7
Tenant	25	5.8	53.2	44	3.9	37.0
Laborer	4	0.9	8.5	4	0.9	3.4
Other crop						
Total	10	2.3	100.0	48	4.2	100.0
Landowner	7	1.6	70.0	30	2.6	62.5
Tenant	0	0.0	0.0	8	0.7	16.7
Laborer	3	0.7	30.0	10	0.9	20.8
Total	430	100.0		1137	100.0	

[a] Sample restricted to those indicating primary occupation was either a landowner, tenant, or laborer, both now and in 1977, when BUSCO was starting operations.

Table 3.4, which presents data for the previous occupations of households presently engaged in sugar production, shows that this is indeed the case. For a majority of households, tenancy status does not change (e.g., landowners before are landowners now). However, 40 percent (21 out of 52) of households presently identified as sugar laborer households used to be corn landowning or corn tenant households before the BUSCO mill was built. Another 40 percent (22 out of 52) are in-migrants 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 ranks of the preexisting pool of corn laborers.

Except for the in-migrants, almost all households that switched to sugar production were involved in corn production before. 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 corn producers reported in Tables 3.2 and 3.3. This suggests that the situation of corn households in areas further away from the mill is indeed representative of the situation of households in the vicinity of the mill, if the sugar mill had never been built.

Table 3.5 gives some indication of the distribution of the sizes of the farms being operated by corn and sugar landowners. To shorten the time of the questionnaire, respondents were asked only to indicate whether the land that they owned or cultivated fell into one of three categories: less than 5 hectares, between 5 and 15 hectares, or more

Table 3.4--Households presently involved in sugar production by type of land tenure, by previous occupation and type of land tenure, and by municipalities close to and far away from BUSCO

Previously Employed in Agriculture As:	PRESENTLY ENGAGED IN SUGAR PRODUCTION AS:											
	Three Municipalities Closest to BUSCO				Seven Municipalities Farthest from BUSCO				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

Table 3.5--Percentage distribution of number of landowning corn and sugar producers by size of holding, by municipalities close to and far away from BUSCO, and by present and previous holdings

Time Period	Size of Holding	Presently Corn Producer		Presently Sugar Producer	
		Three Municipalities Closest to BUSCO	Seven Municipalities Farthest from BUSCO	Three Municipalities Closest to BUSCO	Seven Municipalities Farthest from BUSCO
At time of survey	<5 has.	88.4	71.3	71.4	45.5
	5-15 has.	11.6	28.7	28.6	54.5
Before BUSCO	<5 has.	85.0	69.8	37.9	50.0
	5-15 has.	15.0	30.2	62.1	50.0

than 15 hectares. Less than three percent of landowners and tenants responded that their farms were greater than 15 hectares, and they are not included in the calculations shown in Table 3.5. This figure of three percent corresponds closely to information provided in the agricultural census.

As borne out later by the detailed household surveys and as already mentioned in reference to Table 2.2, sugar farms appear to be larger on average than corn farms. For either sugar or corn, farms appear to be larger in the seven municipalities farthest from BUSCO than for those three municipalities closest to BUSCO. Note that roughly 75 percent of corn landowner farms are below five hectares in size, and that there was a negligible increase in the percentage of corn households less than five hectares in size, comparing the situation at the time of the survey with the situation before BUSCO was built. Both these figures are consistent with the information contained in Table 3.1 from the agricultural censuses. Of the four landowner groups shown in Table 3.5, only households presently engaged in sugar production in the three municipalities closest to BUSCO (restricting the sample to farms less than 15 hectares in size) seem to have suffered a deterioration over time in their farm size. Thus, it does not appear that the higher incomes from sugar for our respondent households has augmented the size of their landholdings. Rather, quite the opposite seems to have occurred over time.

CONCLUSION

As already pointed out in Chapter 2, 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 (and presumably also replaced semisubsistence corn and rice production) in the last 15 years or so?

Second, what are the forces driving this redistribution of land in the particular context of the introduction of sugar in southern Bukidnon? Has a new technology been introduced with strong economies of scale? If not, have households perhaps been forced to give up access to their land against their will, given the local political environment under the Marcos regime when the data were collected?

To partially answer this second question, we will need to compare the corn and sugar production technologies in some detail, which is undertaken in the following two chapters. Little evidence is found of any inherent economies of scale in sugar production. Rather the forces that seem to be driving the redistribution of land are the declining fertility and productivity of corn lands, and the know-how and financial resources of the wealthier families, who are in a position to to take advantage of a new income-earning opportunity. Government programs need to be introduced to make these opportunities available to smallholders as well.

4. THE CORN PRODUCTION SYSTEM

INTRODUCTION

The next two chapters will be concerned with describing the corn and sugar production systems in some detail. This will include an analysis of the costs and returns to use of various inputs so as to be able to compare the relative profitability of production of the two crops in Chapter 6. An additional objective will be to disaggregate total labor inputs not only by hired and family days, but also by men, women, and children days so as to gain possible insights into changes in intrahousehold time allocation patterns which might be the result of a switch to sugar production.

To examine the effect of farm size on production allocation decisions, in some tables some corn household groups are further disaggregated into "large" farms and "small" farms. An arbitrary cut-off point of two hectares (average area cultivated per round for all crops), divided corn households with access to land about evenly between these two groups. Almost all sugar owner and owner/renter households fall into the large farm category using this criterion.

PAST TRENDS IN CORN PRODUCTION IN SOUTHERN BUKIDNON

During the post-war period up until the early 1970s, Bukidnon was a region of heavy in-migration. New settlers typically homesteaded on

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 by asking households that grew corn how many years their largest parcel of land had been planted to corn, what average yield they obtained on that plot in the first few years, and what percentage of the harvest they gave to laborers. Respondents were also asked what share they paid to corn harvesters (if applicable) in the specific years 1965, 1970, 1975, and 1980. The results are shown in Tables 4.1 and 4.2.

The striking conclusion from Table 4.1 is that corn yields have fallen dramatically over the past two decades, by more than 50 percent in an average of 13 years. To account for possible confounding factors which may have reduced yields during the survey period, respondents were also asked if their yields were better, worse, or the same now than before, and if worse now, what was the reason for the decline in yields. Eighty-six percent responded that their yields were worse now and of those 86 percent, 82 percent indicated that loss of soil fertility was the primary cause.

Similarly, referring to Table 4.2, shares paid to harvesters have also declined significantly, which reflects the increasing population density in the area. The indicated trends, then, are very pessimistic, those of declining productivity and increasing land pressure. With the construction of the BUSCO sugar mill in 1977, sugarcane production

Table 4.1--Comparison of past and present corn yields, by crop and tenure groups, by large and small farms

Group	Sample Size	Average Hectares Cultivated Per Round	Yield (50 kg sacks of shelled corn)		
			Average Years Ago That Land Was Planted to Corn	Average Yield Then	Average Yield Survey 1984/85
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
Corn-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
Corn-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
Corn-laborers	51	0.3	11.0	34.4	11.7
Land	32	0.5			
No land	19	0.0			
Sugar-owners/renters	30	7.6	13.1	31.8	22.5
Sugar-owners	41	6.3	17.2	41.6	18.2
Sugar-renters	31	3.0	13.1	40.0	18.0
Large	20	3.9			
Small	11	1.2			
Sugar-laborers	54	0.2	9.6	32.9	14.1
Land	26	0.4			
No land	28	0.0			
Corn-other rent	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

Table 4.2--Trend in share of harvest paid to corn laborers

Period	Percent of Harvest to Laborers: Years Calculated From Years Ago That Land Was First Planted to Corn	Percent of Harvest to Laborers: Asked for Response in Specific Years 1965, 1970, 1975, 1980
1958-1962	20.1	...
1963-1967	20.0	20.7
1968-1972	18.9	18.1
1972-1977	17.8	16.1
1977-1982	16.9	14.4
Survey period		
1984/85	12.5	12.5

became a viable alternative for farmers located sufficiently near the mill.

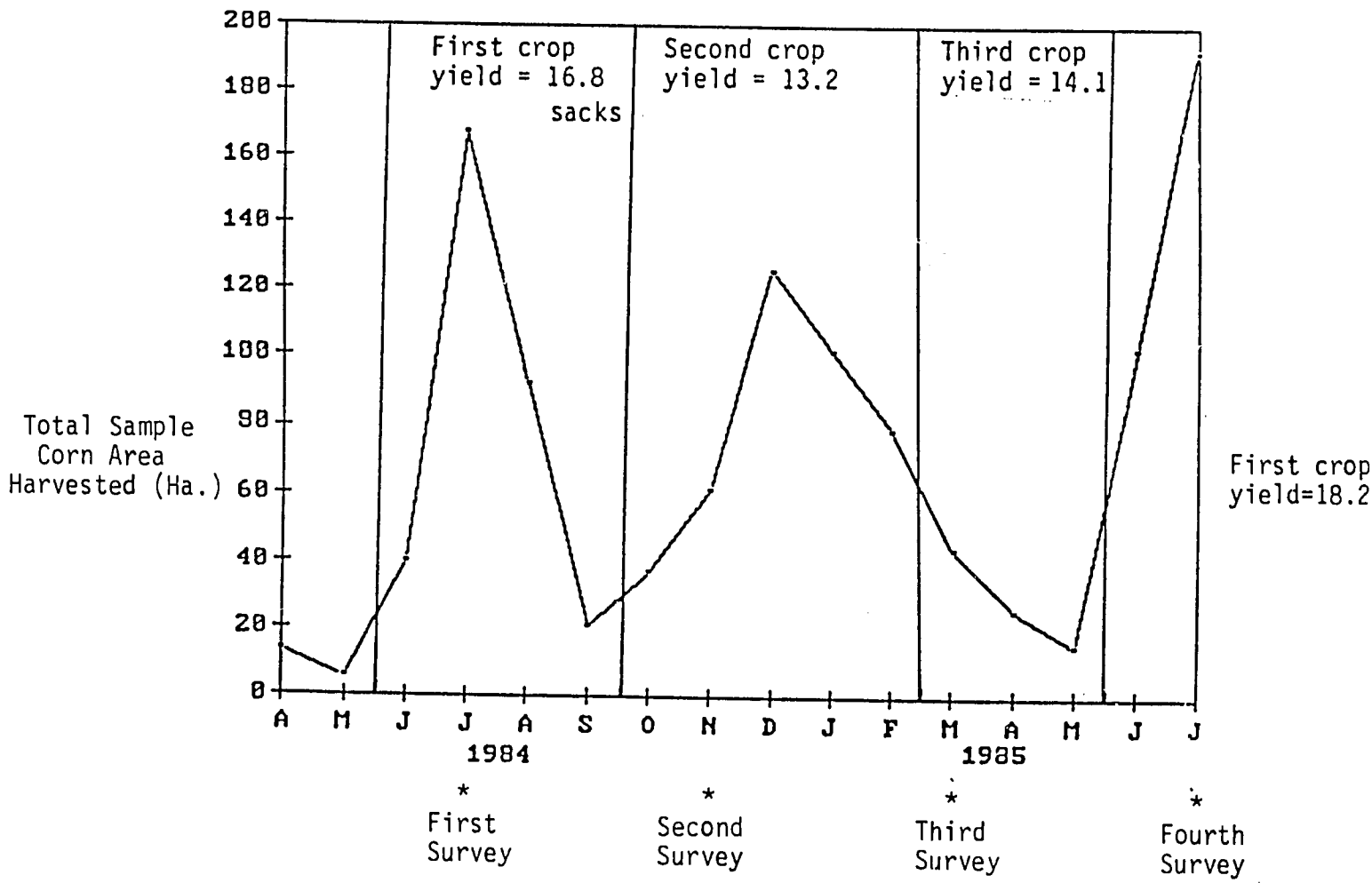
CORN YIELDS FOR THE SURVEY PERIOD 1984/85

We begin our discussion of the corn production system by comparing corn yields observed during the 1984/85 survey period (shown in Table 4.1) across the crop and tenancy groups defined in Chapter 2. The total sample average of 15.7 sacks per hectare (about three-fourths of a ton) is 25 percent below the national average for 1984/85 of 20.6 sacks and 20 percent below the average for Northern Mindanao which was 19.7 sacks. The regional data show that 1984/85 was a better than average year for corn yields (CRC 1987). This is not necessarily indicative of lower corn yields in the study area in that a stratified sample was chosen based on proportion of population, not proportion of area harvested. Thus, smallholder yields are in a sense overrepresented, when comparing the sample average with a regional average.

For corn households, there is little variation across tenancy groups around a 15-sack average, except for corn laborer households whose average yield is somewhat below 12 sacks. Sugar owner and sugar renter yields are marginally higher than the sample average at 18 sacks. Only the sugar owner/renter households (the group with the largest farm size) have average corn yields that are higher than the regional average at 22 sacks.

Figure 4.1 shows the seasonal cropping pattern for corn. Peak harvests occur in July and December. Most of our respondents were able to produce two crops a year. A few households produced three

Figure 4.1--Seasonal cropping pattern for corn production



crops. The average growing cycle from plowing to harvest was 3.3 months so that there is ample time to get in three crops a year. However, getting in a third crop depends on rainfall at the onset of the relatively dry months from March to May. Average yields are highest for the first crop (which were measured twice in our surveys), an average of 17.5 sacks. Yields fell by 25 percent for the second crop to 13.2 sacks.

LABOR INPUTS

Table 4.3 breaks down total labor inputs (per crop per hectare) by family and hired labor. For the total sample average of 51 input days, about two-thirds are accounted for by family labor and one-third by hired labor. There is a stronger tendency for the family labor input to increase as farm size decreases than for hired labor to decrease with farm size. Consequently, total labor inputs are somewhat higher on small farms.

Table 4.4 disaggregates total labor inputs by task. Tractors are used only by farmers with the largest farms and then 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 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 smaller farms to weed more by hand which accounts

Table 4.3--Total labor inputs (input days) per hectare per corn crop, by family and hired labor crop and tenure group, and by large and small farms

Group	Family Labor	Hired Labor	Total Labor
Corn-owners	29.7	23.3	53.0
Large	29.3	24.4	53.7
Small	30.7	20.8	51.5
Corn-owners/share tenants	30.3	14.8	45.1
Large	24.7	16.3	41.0
Small	44.5	11.2	55.7
Corn-share tenants	31.5	15.9	47.4
Large	29.4	15.0	44.5
Small	33.4	16.7	50.1
Corn-laborers	46.3	9.6	55.9
Sugar-owners/renters	20.9	26.3	47.2
Sugar-owners	30.0	19.4	49.3
Sugar-renters	38.7	21.5	60.3
Sugar-laborers	43.9	13.7	57.6
Corn-other rent	27.3	24.9	52.2
Other occupation	37.1	26.4	63.6
Total Sample	32.5	18.6	51.1

Table 4.4--Total labor days per hectare per corn crop, by task, by crop and tenure group, and by large and small farms

Group	Plowing with Tractor	Plowing with Carabao	Harrowing	Furrowing	Planting	Weeding with Carabao	Weeding by Hand	Weeding with Sickle	Fertilizing	Other	Harvesting	Total
Corn-Owners	0.0	10.7	0.4	1.8	4.1	4.8	17.0	1.9	1.3	0.1	9.1	53.0
Large	0.0	11.8	0.4	1.8	4.1	4.6	16.6	2.0	1.3	0.0	8.7	53.7
Small	0.0	8.2	0.3	1.6	4.1	5.2	17.9	1.7	1.4	0.2	10.1	51.5
Corn-Owners/S.T.	0.1	7.8	0.3	1.7	3.8	4.3	15.1	2.2	0.7	0.1	10.8	45.1
Large	0.1	8.0	0.2	1.8	3.7	4.6	10.9	1.9	1.0	0.0	10.7	41.0
Small	0.0	7.4	0.3	1.3	4.0	3.3	25.9	3.0	0.0	0.4	11.0	55.7
Corn-Share Tenants	0.0	10.0	0.6	1.9	4.1	4.7	14.8	1.3	0.7	0.0	9.5	47.4
Large	0.0	8.9	0.6	1.8	3.7	4.6	14.1	1.7	0.7	0.0	8.5	44.5
Small	0.0	10.9	0.6	2.0	4.6	4.8	15.5	0.9	0.7	0.0	10.6	50.1
Corn-Laborers	0.0	7.7	0.3	1.6	4.7	2.9	24.3	3.5	0.7	0.2	9.9	55.9
Sugar-Owners/Renters	0.2	7.8	0.7	2.2	4.2	6.6	11.5	0.1	1.9	0.0	12.1	47.2
Sugar-Owners	0.0	10.4	0.6	2.1	5.3	4.7	13.2	0.4	1.8	0.0	10.6	49.3
Sugar-Renters	0.0	9.6	1.1	2.1	5.2	5.5	21.4	0.4	2.1	0.1	12.5	60.3
Sugar-Laborers	0.0	7.0	0.3	1.1	4.1	2.3	32.2	2.1	0.8	0.5	7.2	57.6
Corn-Other Rent	0.1	10.3	0.5	1.9	3.8	5.1	18.9	1.5	0.6	0.0	9.6	52.2
Other Occupation	0.0	8.7	0.4	2.3	4.4	3.7	30.8	1.7	0.2	0.0	11.4	63.6
TOTAL SAMPLE	0.0	9.3	0.5	1.8	4.3	4.5	17.9	1.5	1.0	0.1	10.1	51.1

for the higher total family labor inputs noted in Table 4.3 for smaller farms.

Input demand estimations (not shown) indicate that for every owned carabao per hectare cultivated, a household increases its total carabao usage for all tasks by a net of 4.7 days, renting 2.0 fewer carabao days, but using the owned carabao 6.7 more days. The particular task of weeding by hand is reduced by 4.3 days and the task of weeding with a carabao increased by 1.4 days, or a substitution ratio of about three to one. While a large farm household owns an average of about twice as many carabaos as a small farm household, there is little to distinguish among the various crop, tenure, and size groups, comparing them on an owned carabao per cultivated hectare basis. Thus, factors other than carabao ownership apparently explain why weeding by hand inputs are higher for small farm households.

MEN, WOMEN, AND CHILDREN LABOR PARTICIPATION RATES

Table 4.5 breaks down family and hired labor inputs by men, women, and children. A child is defined here as someone 18 years of age and under. No adjustment was made for the presumed lower productivity of child labor. Of the 32.5 days of family labor inputs 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 very instructive to break down these participation rates by task as is done in Table 4.6. The basic pattern is for men to do almost all of the work for tasks associated with use of a carabao. The

Table 4.5--Total labor inputs per hectare per corn crop by family and hired labor by men, women, and children

Group	Family			Hired		
	Men	Women	Children	Men	Women	Children
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
Corn-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
Corn-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
Corn-laborers	24.7	10.3	11.3	6.0	3.3	0.3
Sugar-owners/renters	11.8	2.9	6.2	19.6	5.9	0.8
Sugar-owners	15.7	2.7	11.7	12.8	5.0	1.5
Sugar-renters	18.8	5.0	15.0	13.5	7.2	0.8
Sugar-laborers	20.5	6.9	16.5	9.0	2.3	2.5
Corn-other rent	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

Table 4.6--Women and children participation rates for various tasks in corn production by family and hired labor, all households

Task	Participation Rate			
	Family Labor		Hired Labor	
	Pct. Women	Pct. Children	Pct. Women	Pct. Children
Tasks involving carabao (4 tasks)	.01	.08	.02	.00
Planting	.33	.47	.47	.06
Weeding by hand	.23	.35	.17	.08
Weeding with sickle	.15	.35	.09	.00
Fertilizing	.34	.39	.23	.06
Harvesting	.34	.33	.38	.10

remaining tasks are shared by husband, wife, and (to the extent applicable) several children. Thus, for example, households which do more weeding by hand and less weeding with a carabao (households which have a low carabao to area harvested ratio) will tend to show higher participation rates by women and children in agricultural production.

FERTILIZER USE AND WAGE RATES

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

Where payments were made on a piece-rate basis or in-kind, a wage was imputed for that activity by dividing the total peso amount received (a market value was assigned to in-kind payments) by the number of days worked. For all tasks except harvesting, the average wage rate received was around seventeen pesos per day. Harvesting received a substantially higher wage, about twenty-eight pesos 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.

PRODUCTION FUNCTION ESTIMATIONS

Simple Cobb-Douglas production function estimations were run (not shown) as a way to validate the survey production data and to see if farmer behavior was consistent with profit maximization. The coefficients for tractor days, kilograms of nitrogen, and carabao weeding days were all significant, generally robust, and of reasonable magnitudes in comparing their marginal value products with their marginal costs.

The coefficients for carabao plowing days and hand weeding days, however, were insignificantly different from zero. Further analysis of the data across various sub-ranges, showed that high-input observations for these latter two variables were causing the low and insignificant coefficients. In the case of plowing, some corn plots may have been especially overgrown with weeds, such that extra plowing may have been needed just to make normal cultivation possible. In the case of hand weeding, an important component of total labor input is children's labor, whose contribution may need to be adjusted downward.

The production function estimations demonstrate that farmer behavior in general is consistent with profit-maximizing behavior, although some increase in fertilizer inputs would appear to improve profits, even with the traditional varieties that most farmers were using. It would be important to know what factors are presently limiting the adoption of two more input-intensive corn technologies that are already available in the region, a high-risk, high-cost, but high-profit hybrid variety, and a lower-risk, lower-cost, but less profitable open-pollinated technology.

PRODUCTION EXPENDITURES

Table 4.7 gives an accounting of total production expenditures incurred by the household by cash and in-kind costs. Family labor and inputs owned by the household (carabaos, seed inputs) are not included in this accounting. The data show an average production cost per hectare of about 650 pesos. 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 that 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 200 pesos cash per hectare per crop. Sugar households (apart from the laborer group) invested the largest amounts of cash, an average of about 600 pesos per hectare per crop.

POSTHARVEST DISPOSITION OF CORN AND PROCESSING COSTS

Table 4.8 gives an indication of differences across groups in the final end use of the corn produced. The first column shows per capita production of corn per week of shelled corn for the sixteen months covered by our surveys. Although there was some variation in yields across groups (see Table 4.1), for the most part differences across groups in per capita production are due primarily to differences in hectares planted to corn and secondarily to differences in household

Table 4.7--Total expenditures per hectare per corn crop by cash and in-kind wages and by cash paid for nonlabor inputs, by crop and tenure groups, and by farm size

Group	In-Kind Wages	Cash Wages	Cash for Non-Labor Inputs	Total Wage	Total Cash	Total Expen-diture
Corn-owners	231	187	277	417	463	694
Large	230	214	262	444	476	706
Small	233	121	311	353	432	665
Corn-owners/share tenants	229	117	240	346	357	586
Large	229	150	305	379	455	684
Small	227	34	74	261	108	335
Corn-share tenants	245	99	227	344	326	571
Large	231	99	213	330	312	543
Small	258	99	239	357	338	597
Corn-laborers	181	38	134	220	172	353
Sugar-owners/renters	356	245	512	601	756	1113
Sugar-owners	247	161	350	408	512	758
Sugar-renters	252	161	388	413	549	801
Sugar-laborers	187	111	130	297	241	428
Corn-other rent	246	238	301	484	539	784
Other occupation	236	214	200	450	413	650
Total Sample	241	142	265	382	406	647

Table 4.8--Per capita production and consumption out of own production (kgs. shelled corn per week), by crop and tenure group, by farm size

Group	Per Capita Production	Per Capita Production Net of In-Kind Cost	Per Capita Consumption Out of Own Production	Percent Sold Out of Net Production
Corn-owners	6.8	5.9	2.1	0.64
Large	7.7	6.7	2.2	0.67
Small	4.2	3.5	1.8	0.49
Corn-owners/share tenants	10.4	8.2	1.9	0.77
Large	12.4	9.9	2.0	0.80
Small	3.4	2.6	1.6	0.36
Corn-share tenants	7.7	4.7	1.7	0.63
Large	9.7	6.0	1.8	0.69
Small	5.5	3.3	1.6	0.49
Corn-laborers	1.2	0.8	0.5	0.34
Sugar-owners/renters	6.0	4.7	1.2	0.74
Sugar-owners	4.7	4.1	1.5	0.63
Sugar-renters	5.4	3.7	1.1	0.72
Sugar-laborers	0.7	0.4	0.2	0.50
Corn-other rent	6.7	5.2	1.9	0.62
Other occupation	0.9	0.7	0.5	0.29
Total Sample	5.2	3.9	1.3	0.67

size across groups. Not surprisingly, then, per capita production is higher for large farms than small farms, and higher for corn households than for sugar households.

The second column subtracts in-kind payments of corn from the first column. These consist of payments to harvesters and landlord shares. For pure owners this constitutes between a 12 and 14 percent reduction for harvesters. For pure tenants an additional 25 percent or so is subtracted for the landlord share. The third and fourth columns show per capita consumption levels of corn that is own-produced and the percent that is sold. For corn households per capita consumption of home-produced corn on small farms is only marginally lower than on large farms (with the excention of laborer households), suggesting that households keep what they need for home consumption and sell the rest. This results in a much lower percentage marketed for small farms. Per capita consumption of own-produced corn for sugar households is much lower than for corn households despite the fact that they produce sufficient corn (again with the exception of laborer households) to have consumption levels equal to those of the corn households. As will be seen in Chapter 7, sugar households buy substantially more rice in the market than do corn households.

Once harvesting is completed and shares distributed to harvesters and landlord, the corn needs to be shelled and dried. Once it is dried and sacked, although some sacks are sometimes stored temporarily, the sacks need to be hauled to market either for sale or milling into grits for home consumption. Corn which is milled into grits then must obviously be transported back to the farm. A byproduct of the milling

process is corn bran. This bran may either be hauled back to the farm for livestock feed or sold.

Less than ten percent of corn was sold to buyers who came with their own transportation to the farms themselves. All corn sold at the market was shelled. Some corn sold at the farm had not been shelled. All corn milled into grits was kept for home consumption; no corn was marketed in grit form.

Data collected on the cost and amount of time spent in various processing tasks indicate an implicit wage which is equal to the wage paid for harvesting. Adding the cost per sack of shelling, drying, and a portion of hauling costs to obtain an estimate of labor costs per sack (which came to ₱6.25), multiplying that cost per sack by the average total sample yield of 15.7 sacks per hectare, and dividing by the average harvest wage per day, gives an estimate of 3.5 days of total labor per hectare that goes into processing, a marginal increase of about 7 percent over the total labor input per hectare reported in Table 4.3. This information will be used later in Chapter 6.

As noted from Table 4.8, a substantial amount of corn is kept for home consumption. Since farmers have to go to the trouble of bringing their shelled corn to the local mill for milling into grits anyway, what cost advantage is there to consuming out of home production? Using round numbers, the farmer who brings a sack of corn to the mill has two choices: (1) to sell that sack for ₱125 and purchase food in the market or (2) to pay to have that sack milled and to bring home 35 kilograms of corn grits and 15 kilograms of corn bran (the surveyed milling rate was 0.705; according to our respondents there is little if

any weight loss when adding grits plus bran). At market prices of ₱4.92 and ₱0.95 per kilo for corn grits and corn bran, respectively, under option two the farmer brings home corn products worth ₱186, after paying ₱15 for the milling service, giving a net value of ₱171. The amount saved, using option two over option one, is ₱46 or 25 percent of the market price.

Miller-retailers selling in Bukidnon, then, make a profit of about 25 percent on any corn that they turn over, less any storage and retailing costs, plus any profit that is made in milling. The corn market in Bukidnon is apparently highly competitive. It is interesting to note that the market value of corn bran produced from one sack of shelled corn is almost exactly equal to the cost of milling that sack (₱15). Thus, farmers short on cash who bring their shelled corn in for milling can leave the bran with the miller in lieu of a cash payment for the milling service.

CALCULATION OF NET RETURNS TO CORN PRODUCTION

The calculation on net returns per hectare to corn production, shown in Table 4.9, is made on a variable cost basis. In the total revenues column, average yield is multiplied by the price received per sack by the household for any output sold (any household consuming its entire production was assigned a value of ₱125). This implicitly values home consumption at this farmgate price. Preharvest production costs per hectare are given in the second column. In-kind costs are meals given to hired workers and do not include household-owned inputs such as carabao and seed. In-kind costs in the third column are sacks

Table 4.9--Total revenues and net revenues per hectare per corn crop by crop and tenure group, and by farm size

Group	Total Revenues Per Ha.	Cash and In-Kind Costs Pre-Harvest	In-Kind Costs Post-Harvest (Landlord and Harvester Share)	Cash Processing Costs	Net Revenues Per Ha.
Corn-owners	1,782	500	208	37	1,038
Large	1,809	517	192	43	1,057
Small	1,718	460	246	20	993
Corn-owners/s.t.	2,214	365	421	38	1,390
Large	2,393	463	419	52	1,459
Small	1,757	115	425	2	1,215
Corn-share tenants	1,806	349	664	20	774
Large	1,804	332	646	24	802
Small	1,809	365	680	16	748
Corn-laborers	1,236	178	365	9	685
Sugar-owners/renters	2,850	789	697	50	1,315
Sugar-owners	2,466	519	252	30	1,665
Sugar-renters	2,360	565	718	36	1,041
Sugar-laborers	1,638	256	586	46	780
Corn-other rent	1,857	563	325	30	940
Other occupation	1,712	481	403	10	818
Total Sample	1,961	429	480	29	1,023

of shelled corn paid to harvesters and landlords and are valued at the same price as used for the total revenues column (almost no corn was grown on land rented at a fixed rate; even the sugar renter groups rented their corn land on a share basis, but rented their sugar land on a fixed rent basis). Small amounts of cash wage payments are also added to this column. Cash payments for processing (shelling, drying and hauling; not milling) are given in column four. No in-kind payments were made for processing costs. Calculation of net revenues, then, is the result of subtracting the three categories of costs from total revenues. Interest payments on cash borrowed, which are small, are not included here, but are discussed in Chapter 6.

The bottom line indicates that average returns to corn production are a dismal 1,023 pesos per hectare per crop (U.S. $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. Chapter 6 will show that by valuing family labor and household-owned inputs at the going market rates, these renter households do little better than if they had hired out their labor and family-owned inputs in the market. Owner households, especially sugar owner households, do somewhat better because rents on land have not been subtracted. However, some valuation of the opportunity cost of their land will be made in Chapter 6.

5. THE SUGAR PRODUCTION SYSTEM

INTRODUCTION

Chapter 5 will undertake much the same type of analysis for sugar production as was just undertaken for corn production in Chapter 4. Comparisons of the profitability and labor utilization for corn and sugar will be made in Chapter 6.

One of the primary differences between the two crops is the way processing and marketing is 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, the situation is different in the sense that production must be coordinated among several producers so that milling capacity is as fully utilized as possible without over-production. The chapter begins with a description of the system used by BUSCO to coordinate this production and how farmers have adapted to this system.

Another basic difference between production of the two crops is the length of the growing period--3.3 months on average for corn for our sample households and 12 months for sugar. For sugar, 12 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, so that for sugar it is instructive to break down costs for planting and ratoon crops, in

addition to presenting average costs for the mix of plant and ratoon crops that exists for our sample.

MANAGEMENT OF SUGARCANE DELIVERIES AND THE ROLE OF PRODUCER CONTRACTS

The sugar milling season begins in late October and finishes in late July. The sugar content (piculs of sugar per ton of cane or PS/TC) 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 would prefer 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 which revolves around the "bagon" (wagon), or metal carrier which sits on a truck bed and is lifted by cranes for dumping the cane onto a conveyor belt at the mill.

The mill can process about 600 bagons of cane in a 24-hour period and each bagon holds from 10 to 12 tons of cane. This implies that the capacity of the mill is between 6 and 7,000 tons of cane per day. Average yields are assumed to be between 60 to 70 tons of cane per hectare, so that it takes about six trips to the mill with one bagon to harvest one hectare. During the nine-month milling season, the mill is estimated to be in operation about 250 days (275 days less 25 days for cleaning and other down time). Dividing these 250 days by six bagon trips per hectare (one bagon trip per day) indicates that one bagon can service 42 hectares of land in a milling season.

Each of 600 42-hectare tracts are assigned a bagon for the milling season. Only 600 bagons exist, each is assigned a number, and only

cane arriving in one of the authorized bagons is accepted by the mill. A planter with 420 hectares is assigned 10 bagons for his own use. Farmers with less than 42 hectares are formed into groups, called "seldas," whose milling contracts sum up to 42 hectares. Farmers within each group must then meet and agree among themselves the scheduling for use of the bagon throughout the milling season. Disputes among selda members are resolved by the management of the Sugar Planters Association.

Such a system of bagon allocation not only assigns each farmer a fraction of the total milling capacity which is proportional to the amount of land under each individual contract, but allows each individual farmer to plan his own production schedule (in consultation with other selda members) while ensuring that no individual growers are favored and that the mill can operate at near-capacity throughout the milling season. Farmers or seldas that do not take advantage of the bagon capacity assigned to them early in the milling season, when the PS/TC is relatively low, run a high risk of not being able to harvest all of their sugar before the milling season ends due to the constraint of bagon capacity.

Several of our sugar household respondents had no contracts with the mill. As an example of how these households are accommodated, suppose that a farmer has a contract for 10 hectares, plants only 5 hectares to sugar, but is assigned 10 hectares worth of bagon capacity. That contract and the bagon capacity that goes along with it have a value (for which the planter pays no fee to the mill) which the deficit

producer can rent to a farmer who wants to plant more hectares than his contract calls for, or who does not have a contract at all.

A typical arrangement might be for the surplus grower to sell his cane to the deficit grower at a certain rate per truckload of cane. The deficit planter shows up at the surplus grower's field with his own 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 to the mill, then brings the cane to 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 taken to determine its sugar content. The grower is paid the NASUTRA (National Sugar Trading Agency, the government agency to which mills were required by law to sell their output) price for 60 percent of 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 have been paid, usually within a month of when a truckload of cane is deposited at the mill, a single payment for both sugar and trucking rebate. Toward the end of our 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 in hauling their cane. The growers in our sample are small enough that in all cases they hired private truckers to haul their cane.

SUGAR YIELDS BY MILLING SEASON AND BY RATOON

Table 5.1 shows sugar yields in terms of tons of sugarcane. These figures do not reflect actual sugar content, but data to be presented later will show that the sugar content did not vary much between tenure groups for our sample, so that comparisons of sugarcane yields are accurate reflections of differences in actual sugar output. Aggregate sugar yields fell quite substantially in the second milling season surveyed, from 59 tons in 1983/84 to 38 tons in 1984/85. Production function analysis to be presented later on indicates that this decline in yields is not explained by lower input use.

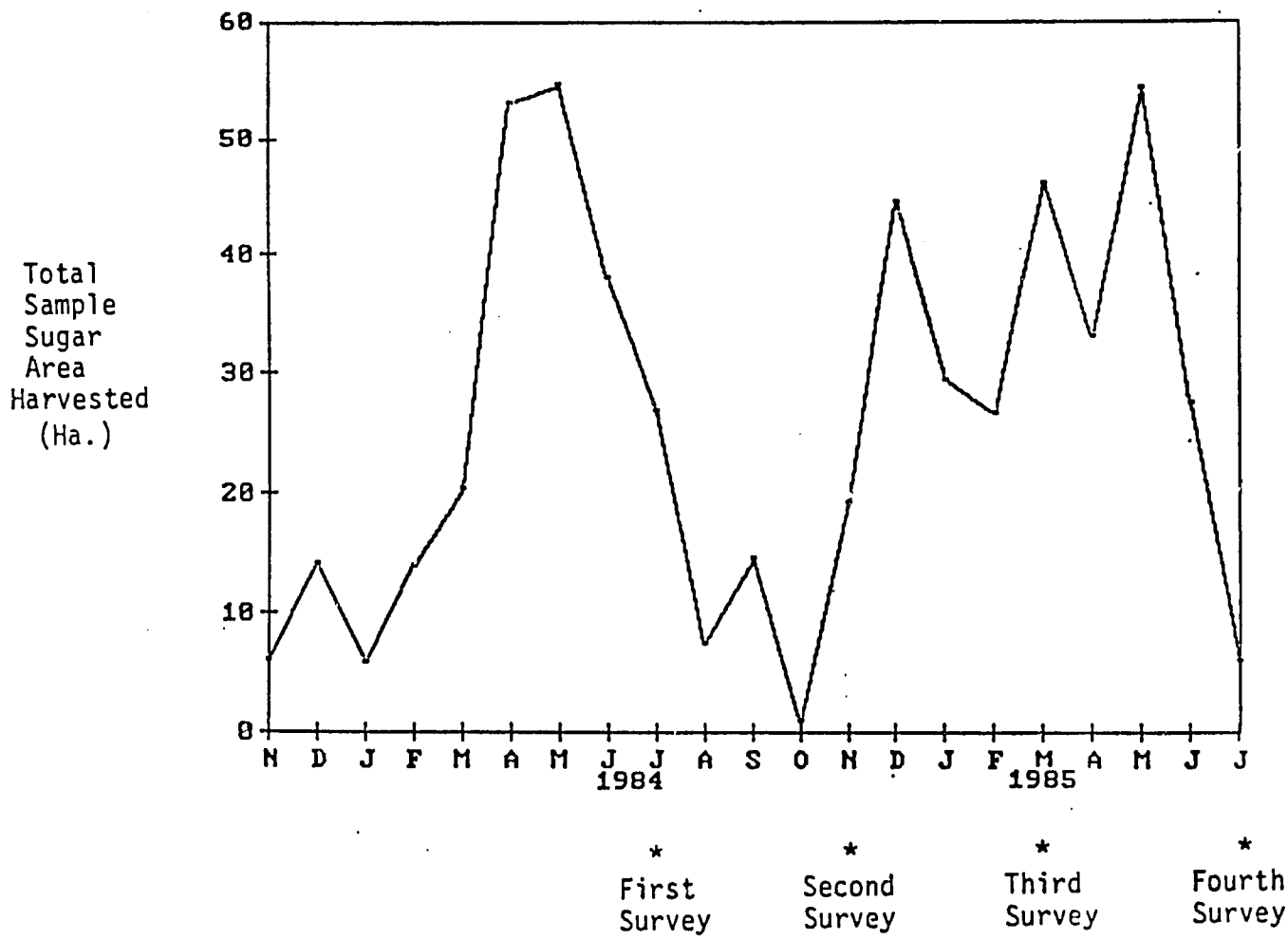
Comparing yields across tenure groups, average yields are nearly identical. There was an almost uniform drop in yields across tenure groups between the two milling seasons. Neither does average ratoon number vary much between groups. Yields do not decline with successive ratoons because fertilizer inputs increase with higher-numbered ratoons, as also can be seen in Table 5.1.

Figure 5.1 shows the seasonal cropping pattern for sugar for our respondent households. Peak harvest months are from March to May, although substantial production takes place in other months as well. The peak harvest months for sugar coincide with months of relatively

Table 5.1--Sugar yields by crop and tenure group and by milling season, and by ratoon number (metric tons of cane per hectare)

	By Milling Season				By Ratoon Number			
Group	1983/84 Milling Season	1984/85 Milling Season	Two Milling Seasons Combined	Average Ratoon Number	Ratoon Number	Two Milling Seasons Combined	Cases	Fertilizer Application (kg. Nitro/ha)
Sugar-owners/renters	53.4	37.3	43.2	1.8	0	45.4	56	4.1
					1	43.6	18	11.3
Sugar-owners	59.5	40.6	49.8	1.7	2	57.5	29	16.0
					3	44.5	32	20.7
Sugar-renters	67.8	35.7	48.3	1.6	4	53.1	13	14.6
Large	82.0	38.5	54.8	1.6	5	20.8	3	2.7
Small	50.8	31.6	39.6	1.6	6	42.0	3	40.4
					7	16.7	1	0.0
Total Sample	59.1	38.3	47.2	1.7	Total Sample	47.2	155	12.1

Figure 5.1--Seasonal cropping pattern for sugar production



low production activity for corn (see also Figure 4.1). The long periods of sunshine that raise the sugar content in sugarcane imply a lack of rainfall for corn production.

LABOR INPUTS

Table 5.2 shows an average total labor input per hectare of 109 days. Total labor inputs for sugar owners of 123 days per hectare are substantially above those for any other group, which is primarily due to a high family labor input. 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.

Table 5.3 breaks down total labor inputs by task. The first four tasks take place only for plant crops, but the average inputs per hectare shown here are for the particular mix of the plant and ratoon crops which occurred for our sample. Weeding accounts for 45 percent of all labor inputs and harvesting for 35 percent. Land preparation accounts 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 with corn, differences across groups in labor inputs for weeding by hand stand out. In this case, however, there does not appear to be a substitution between this task and weeding with a carabao, but rather a positive correlation.

The same input demand functions were run for sugar as were run for corn to examine the effect of carabao ownership on allocation of labor to various tasks. The results (not shown) indicate that each addi-

Table 5.2--Total labor inputs per hectare per sugar crop, by family and hired labor and by group

Group	Family Labor	Hired Labor	Total Labor
Sugar-owners/renters	11.8	87.2	99.1
Sugar-owners	45.4	78.1	123.5
Sugar-renters	28.5	59.2	87.7
Large	24.8	59.7	84.5
Small	33.3	58.6	91.9
Total Sample	31.0	77.6	108.7

Table 5.3--Total Labor Inputs Per Hectare Per Sugar Crop, by Task and by Tenure Group

Group	Plowing, Harrowing, Furrowing, with Tractor	Plowing and Harrowing with Carabao	Furrowing with Carabao	Planting	Preparing Rattoon	Weeding With Carabao	Weeding by Hand	Weeding with Sickle	Fertilizing	Other	Harvesting	Total
Sugar-Owners/ Renters	0.23	2.7	0.4	5.5	3.2	12.7	35.1	1.9	1.0	0.8	35.2	99.1
Sugar-Owners	0.05	4.4	0.8	10.0	3.2	10.0	47.6	1.2	1.9	1.3	42.6	123.5
Sugar-Renters	0.20	3.6	1.4	9.1	2.3	8.3	23.3	2.1	1.6	0.2	35.5	87.7
Large	0.22	4.1	1.6	9.1	2.1	7.7	19.6	1.4	2.7	0.1	35.8	84.
Small	0.17	2.7	1.1	9.1	2.4	9.0	28.3	2.9	0.2	0.3	35.1	91.9
TOTAL SAMPLE	0.13	3.8	0.8	8.3	3.0	10.6	38.7	1.6	1.5	0.9	39.0	108.7

tional owned carabao per hectare cultivated results in a net addition of 12 carabao input days per hectare for all tasks, about two-thirds for land preparation and one-third for weeding. Weeding by hand and use of a tractor are both negatively related to carabao ownership per hectare cultivated, indicating substitution with carabao use, but the coefficients are not statistically significant.

MEN, WOMEN, AND CHILDREN PARTICIPATION RATES

Tables 5.4 and 5.5 disaggregate family and hired labor by men, women, and children participation rates. Again, no adjustment is attempted here for the presumed lower productivity of child labor. Women contribute 9 percent of family labor and 11 percent of hired labor, lower percentages than for corn. As with corn, with respect to family labor, women are almost entirely excluded from tasks involving a carabao and participate, along with several children, in all other tasks, with the exception in this case of preparing the ratoon. With respect to the hired labor force, women's participation rates fall when compared to corn primarily due to the exclusion of women from harvesting.

Participation of children in the hired labor force, as with corn, is virtually nonexistent. Their participation with respect to family labor (in percentage terms) is higher than for corn. Note the especially high contribution of children's family labor for the sugar owner group in Table 5.4, which is a reflection of the presence of teen-age children in these households. Table 2.2 indicates that

Table 5.4--Total labor inputs per sugar crop by family and hired labor, by men, women, and children

Group	Family			Hired		
	Men	Women	Children	Men	Women	Children
Sugar-owners/ renters	8.5	0.6	2.7	77.6	9.1	0.5
Sugar-owners	20.7	3.8	20.9	67.7	9.0	1.4
Sugar-renters	19.5	3.5	5.4	52.5	6.3	0.4
Large	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

Table 5.5--Women and children participation rates for various tasks in sugar production by family and hired labor, all households

Task	Participation Rate			
	Family Labor		Hired Labor	
	Pct. Women	Pct. Children	Pct. Women	Pct. Children
Tasks involving carabao (4 tasks)	.00	.12	.00	.00
Planting	.17	.50	.32	.04
Preparing ratoon	.04	.31	.00	.00
Weeding by hand	.12	.53	.24	.02
Fertilizing	.12	.60	.39	.03
Harvesting	.26	.26	.02	.00

parents in this group have been married longer and have more children than any other crop-tenancy group.

FERTILIZER USE AND WAGE RATES

Average fertilizer usage per hectare per crop is between two and three times higher than for corn, although the duration of the growing cycle is much longer for sugar than for corn. The sugar-owner/renter group uses the most fertilizer, 16 kilograms of nitrogen per hectare, which is still quite low. As already mentioned, most of this fertilizer is put on higher-numbered ratoons.

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 to harvesters is substantially higher than for other tasks, and about equal to the wage paid to corn harvesters at twenty-seven pesos per day.

PRODUCTION FUNCTION ESTIMATIONS

Much the same procedure was followed to estimate a production function for sugar yields as was done for corn yields. The regression estimations (not shown) demonstrate that, as with corn, the marginal value product of an additional kilogram of nitrogen evaluated at the mean input level is well above its marginal cost, indicating some constraint to higher input use which would increase profits.

Another similarity with the corn production function estimation was the significance of the coefficient on carabao weeding days, whose

marginal value product also earns more than its marginal cost. As with corn, the coefficients on carabao plowing days and weeding by hand are insignificant. However, tests on lower input observations for these steps for sugar, as contrasted with corn, did not show any different behavior than for high input observations. There is a high positive correlation between weeding with a carabao and weeding by hand, which may explain the poor results for this latter step.

The coefficient on tractor days is insignificant and the marginal value product does not come close to earning its marginal cost. This is not so much of a concern since positive values are only observed for plant crops (not for ratoon crops). The input level for this step may have an effect on latter ratoon crops which will not be picked up by the regression equation. At any rate, this type of plowing may be regarded as a fixed cost of production.

A zero-one dummy for the 1983/84 milling season proved highly significant. Experiments attempted using various formulations of dummy variables for ratoon numbers all gave insignificant coefficients.

PRODUCTION EXPENDITURES PER HECTARE

Total production expenditures per hectare are given in Table 5.6. The average expenditure for all groups is 2,200 pesos, virtually all of which is paid out in cash. Thus, not only are production expenses much higher per crop per hectare than 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 expendi-

Table 5.6--Total expenditures per hectare per sugar crop by cash and in-kind Wages, and by cash paid for nonlabor inputs, by group (all ratoons)

Group	In-Kind Wages	Cash Wages	Cash for Non-labor Inputs	Total Wage	Total Cash	Total Expenditure
Sugar-owners/ renters	18	1633	832	1651	2465	2483
Sugar-owners	45	1433	702	1478	2135	2180
Sugar-renters	8	1272	702	1280	1974	1982
Large	11	1354	870	1365	2224	2235
Small	4	1163	478	1167	1641	1645
Total Sample	29	1467	746	1496	2213	2242

tures for the small sugar renter group are well below the average due to lower levels of nonlabor inputs.

Table 5.7 gives total expenditures by plant crop and ratoon crops, respectively. Plant crop expenses are, on average, about 800 pesos more per hectare than ratoon crop expenses. If fertilizer applications had been constant across plant and ratoon crops, this differential would have been even larger.

TOTAL REVENUES AND NET REVENUES PER HECTARE

Calculations for total revenues and net revenues per hectare are made separately for the 1983/84 and 1984/85 milling seasons, since yields and prices received varied considerably. As already pointed out in Table 5.1, yields fell for the 1984/85 milling season; however, the price received increased substantially such that 1984/85 turned out to be more profitable.

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 of sugar stood at 85 pesos. Toward the end of the milling season, this price was raised to 96 pesos. By the beginning of the 1984/85 milling season, this price had increased to 107 pesos and, at about the middle of the milling season, the price increased sharply to 171 pesos per picul (the result of a devaluation of the peso). Weighted averages of 86 and 147 pesos per picul for the 1983/84 and 1984/85 milling seasons, respectively, are used in the revenue calculations to follow.

Table 5.7--Total expenditures per sugar crop (cash plus in-kind) by plant and ratoon crops, by tenure group

Group	Plant Crops	Ratoon Crops
Sugar owner/renters	3,235	2,206
Sugar owners	2,665	1,884
Sugar renters	2,494	1,538
Large	2,562	1,907
Small	2,385	1,116
Total Sample	2,750	1,955

The prices quoted above are prices received by farmers in terms of sugar equivalent for all cane delivered to the mill. As already discussed, the mill uses a different accounting system in which mill quotes a higher price, but considers 40 percent of the cane delivered as its share. Converting to U.S. cents per pound, this comes out roughly to 5 cents and 9 cents per pound, or an average of 7 cents for the two milling seasons that NASUTRA paid the mills for their sugar (just over 4 cents of which went to producers).

An often-quoted figure for cost of production of sugar in the Philippines is 11 cents per pound, which is inclusive of milling and other costs involved in exporting sugar. Even adding a sizeable margin to 7 cents for costs of exporting, prices received by our respondents at the farmgate were evidently below this 11-cent figure. Thus, farmers in our survey received a price below what are considered average costs of production for the country as a whole, but nevertheless somewhat above the very low world price prevailing at the time (on the order of 4-5 cents per pound, a price which includes milling and exporting costs).

In Tables 5.8 and 5.9, total revenues per hectare are calculated by multiplying average yield times average piculs per ton of cane times the prices paid per picul as stated above. Costs of transporting the cane to the mill, production costs, and rent on land are then subtracted to obtain net revenues per hectare.

On average those outside of the 20-kilometer radius spent an average of ₱50 per ton (net of rebate) to haul cane to the mill while those inside spent only about ₱30 per ton. Multiplying the ₱20

Table 5.8--Total revenues and net revenues per hectare per sugar crop, by group, 1983/84 milling season

Group	Average Yield	Piculs Sugar Per Ton of Cane	Price Per Picul	Total Revenues	Transportation Costs Net of Rebate	Production Costs	Rent on Land	Net Revenues Per Hectare
			(Pesos)	(Pesos)				
Sugar-owners/ renters	53.4	1.71	86	7816	1869	2266	625	3056
Sugar-owners	59.5	1.65	86	8404	2083	2327	-	3994
Sugar-renters	67.8	1.65	86	9576	2373	2473	2175	2555
Large	82.0	1.65	86	11582	2870	3146	2175	3391
Small	50.8	1.65	86	7175	1778	1666	2175	1556
Total Sample	59.1	1.67	86	8448	2069	2334	340	3705

Table 5.9--Total revenues and net revenues per hectare per sugar crop, by group, 1984/85 milling season

Group	Average Yield	Piculs Sugar Per Ton of Cane	Price Per Picul	Total Revenues	Transportation Costs Net of Rebate	Production Costs	Rent on Land	Net Revenues Per Hectare
			(Pesos)	(Pesos)				
Sugar-owners/ renters	37.3	1.63	147	8937	1306	2608	625	4398
Sugar-owners	40.6	1.67	147	9967	1421	2040	-	6506
Sugar-renters	35.7	1.57	147	8239	1250	1664	2175	3150
Large	38.5	1.57	147	8885	1348	1688	2175	3674
Small	31.6	1.57	147	7293	1106	1629	2175	2383
Total Sample	38.3	1.65	147	9290	1341	2174	340	5435

differential by an average yield of 45 tons gives ₱900, the extra amount per hectare which those outside the 20-kilometer radius have to pay (on average) for transportation costs. This differential should be kept in mind in evaluating the net revenue figures given in Tables 5.8 and 5.9, which evaluate costs at a distance of 20 kilometers from the mill.

Average returns per hectare per crop for sugar are well above those for corn. As with corn, landowners do better than renters because of the variable cost accounting method used. Economic returns to the production of the two crops will be examined more closely in the following chapter.

6. COMPARING CORN AND SUGAR PRODUCTION: ECONOMIC PROFITS, CHANGES IN LABOR ALLOCATION PATTERNS, OTHER SOURCES OF INCOME

INTRODUCTION

We have seen from Chapters 4 and 5 that, although net revenues per hectare from sugar and corn production are both low, sugar production is substantially more profitable from a short-run, variable cost point of view. This chapter will compare profits from production of these two crops from a longer-run perspective, taking into account imputed values for interest on cash inputs, family labor, land, and other non-labor inputs owned by the household. Data will show that land values in the vicinity of the mill have risen as a consequence of higher profits from sugar.

The analysis in Chapters 4 and 5 demonstrates a substantial shift away from use of family labor to use of hired labor, and away from use of women's and children's labor to use of men's labor. The underlying causes for these shifts in labor allocation patterns will also be discussed below.

Finally, although a large part of household incomes are derived from corn and sugar production, on average more than half of total incomes are earned from other activities. These include production of other crops for commercial sale, backyard livestock, vegetable, and fruit production, nonagricultural wage employment, and profits from

small business enterprises. These other sources of income, which cushion households from the effects of fluctuations in corn and sugar incomes due to weather and variable prices, are compared across the various crop and tenure groups.

ECONOMIC PROFITS

Tables 6.1 and 6.2 take net revenues calculated in Tables 4.9, 5.8, and 5.9 (a simple average of the values in Tables 5.8 and 5.9 was used) for corn and sugar, respectively, and then subtract imputed values for family labor, inputs for carabaos owned by the household, interest on cash inputs, and rents on owned land. A wage of ₱17 per day was used to value men's and women's labor. Children's labor was arbitrarily valued at half of this wage. Carabao inputs were valued at ₱12.50 per day. All these values applied to both corn and sugar calculations.

An interest rate of 20 percent (total over the average 3.3-month growing cycle) was used for corn cash expenditures. An interest rate of 35 percent (total over the average 12-month growing cycle) was used for sugar cash expenditures. On an annualized basis, the interest rate for sugar producers is considerably lower. Sugar producers typically have access to institutional credit which is available at much lower rates than rates prevailing in the informal credit sector, the traditional source of corn production credit. Nominal institutional credit rates were quite high during the survey period due to steps taken by the Central Bank to control inflation. Although these nominal interest rates eventually came down, during the period of our survey

Table 6.1--Corn production profits per hectare per crop, by group

Group	Net Revenues Per Ha.	Family Labor				Carabao Inputs		Interest on Cash Inputs		Sub-Total	Rent on Owned Land	Net Profit Per Ha.
		Men	Wom.	Chl.	Imputed Value	Days	Imputed Value	Cash Amount	Imputed Value			
	(Pesos)				(Pesos)		(Pesos)		(Pesos)	(Pesos)	(Pesos)	(Pesos)
Corn-owner	1038	20.8	5.3	6.1	436	10.5	131	463	93	318	447	-129
Large	1057	19.5	5.9	6.5	487	10.7	134	476	95	341	447	-106
Small	993	23.9	3.9	5.4	519	9.8	123	432	86	265	447	-182
Corn-owner/s.t.	1390	19.7	6.1	6.8	496	9.7	121	357	71	702	292	410
Large	1459	16.3	6.1	4.8	422	10.6	133	455	91	813	315	498
Small	1215	28.3	6.2	12.5	693	7.6	95	108	22	405	233	172
Corn-share tenant	774	20.4	5.2	8.4	507	10.1	125	326	65	76	-	76
Large	802	17.9	4.5	9.6	462	10.2	128	312	62	150	-	150
Small	748	22.9	5.8	7.2	549	10.0	125	338	68	6	-	6
Corn-laborer	635	25.7	11.3	11.8	729	10.5	131	172	34	-209	231	-440
Sugar-owner/ renter	1315	12.8	3.9	7.2	345	9.7	121	756	151	698	92	606
Sugar-owner	1665	16.7	3.7	12.2	451	12.9	161	512	102	951	447	504
Sugar-renter	1041	19.8	6.0	15.5	570	12.8	160	549	110	201	-	201
Sugar-laborer	780	21.5	7.4	17.0	636	7.0	88	241	48	8	57	-49
Corn-other rent	940	18.7	6.5	4.6	468	8.7	109	539	108	255	345	-90
Other occupation	818	25.3	11.5	2.9	650	4.7	59	413	83	26	249	-223
Total Sample	1023	20.1	6.2	8.8	522	10.0	125	406	81	109	202	93

Table 6.2--Sugar production profits per hectare per crop, by group

Group	Net Revenues Per Ha.	Family Labor				Carabao Inputs		Interest on Cash Inputs		Sub-Total	Rent on Owned Land	Net Profit Per Ha.
		Men	Wom.	Chl.	Imputed Value	Days	Imputed Value	Cash Amount	Imputed Value			
	(Pesos)				(Pesos)		(Pesos)		(Pesos)	(Pesos)	(Pesos)	(Pesos)
Sugar-owners/ renters	3727	8.5	0.6	2.7	178	4.4	55	2465	863	2631	1625	1006
Sugar-owners	5250	20.7	3.8	20.9	594	9.1	114	2135	747	3795	2250	1545
Sugar-renters	2853	19.5	3.5	5.4	437	7.8	93	1974	691	1627	75	1552
Large	3533	15.1	4.2	5.5	375	7.5	94	2224	778	2286	75	2211
Small	1970	25.4	2.6	5.3	521	8.2	103	1641	574	772	75	697
Total Sample	4570	16.5	2.7	11.9	428	7.4	93	2213	775	3274	1910	1364

inflation declined substantially, resulting in very high real rates of interest.

Before finally subtracting an imputed value for owned land, a subtotal is calculated in Tables 6.1 and 6.2 in which imputed values for family labor, owned-carabao inputs, and interest on cash have been subtracted from net revenues. As has been argued earlier, introduction of sugar probably did not affect the prices of these inputs, or the output price for corn, at the local level.

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 devote 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, those who first started planting corn an average of 18 years ago (see Table 4.1) do less well. Net returns to sugar production are even higher relative to corn than shown in Chapters 4 and 5, since family inputs are greater for corn.

LAND VALUES

The final calculation shown in Tables 6.1 and 6.2 is to subtract imputed rental values on owned land. For corn land, a rental rate of

447 pesos per hectare per crop was used, which is the imputed value of the approximately 3.5 sacks of shelled corn that pure corn tenants gave to their landlords on average per hectare during the survey period. For sugar land, a rental rate of 2,250 pesos per hectare per crop was used, which is the average fixed rent per year that sugar renters paid.

These rental rates should bear some relationship to land values. The average reported land value for all cultivated land owned by corn-associated households was 6,500 pesos per hectare. About two-thirds of area harvested for the corn owner and corn owner/tenant groups is accounted for by corn production.

Dividing 894 (447 pesos times two crops) by 6,500 gives a ratio of almost 14 percent. This ratio may be understated for two reasons. First, corn output is valued at farmgate prices. Corn kept for home consumption is worth 25 percent more at the retail level (see Chapter 4). Second, the worth of higher value crops (than corn), grown on the remaining land, may already be capitalized in average land values, which is the denominator of this ratio.

The average reported land value for all cultivated land owned by sugar-associated households was 9,600 pesos. Area harvested data for the sugar owner and sugar owner/renter groups show that, for each group, about twice as much sugar area was harvested as corn area, these two crops accounting for a little over 85 percent of total area harvested for these households. Assuming again that two corn crops are harvested in one year, this means that 80 percent of sugar and corn land is devoted to sugar. Multiplying 894 pesos by 0.2, adding that to

the product of 2,250 pesos by 0.8, and dividing the result by 9,600 pesos, gives a ratio of just over 21 percent.

If the ratio for corn-associated households is understated for the reasons given above, and/or if land rented out for sugar production is of better quality on average than land rented out to pure corn share tenants, then these two ratios of 14 percent and 21 percent may in fact indicate just about equal rental rates. At an aggregate level, then, as suggested by the higher land values associated with land owned by households located near the sugar mill, it would appear that the higher profits possible with sugar had already been capitalized in land values by the time of our surveys. Subtracting these rental rates in Tables 6.1 and 6.2, several negative entries in the final column in Table 6.1 indicate that these households would have done better to rent out their land at the assumed rate (and entered the labor market) rather than to have undertaken corn production. This is not to say that farmer behavior is inconsistent with utility maximization. Yields 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 93 pesos 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 for sugar-renter households, however, which seem to have "over-invested" family labor in corn production.

ALLOCATION OF LABOR INPUTS

Table 6.3 shows average labor inputs for the total sample for corn and sugar production by family and hired labor and by men's, women's, and children's labor. The corn figures have been doubled to take account of the two corn crops that are harvested for each sugar crop. A total of 3.5 days per hectare per crop has been added to the corn data to take account of labor that goes into the postharvest processing of corn, 2.5 days of family labor and 1.0 days of hired labor (see Chapter 4).

Corn and sugar production use almost identical amounts of total labor. However, the mixes of family and hired labor, and of men's, women's, and children's labor are quite different. About two-thirds of corn labor is provided by the family, while the family provides only about one-third of sugar labor, a net switch of 38 or 39 days.

Are these differences in use of family and hired labor explained by differences in the corn and sugar production technologies, or differences in farmsize? Because sugar household farms are larger on average than corn household farms, family labor availability may be a serious constraint on sugar household farms. To look at this issue, Table 6.4 was constructed, which compares family and hired labor inputs by selected tasks for both corn and sugar.

Table 6.3--Labor inputs for corn and sugar, by family and hired labor, and by participation rates of men, women, and children, total sample

	Corn (x2 crops)	Sugar (1 crop)
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	108.8
Men	66.2	84.7
Women	23.4	11.3
Children	19.6	12.8

Table 6.4--Family days and hired labor per hectare for corn and sugar production for selected tasks, sample average

Selected Task	Family Labor			Hired Labor		
	Corn (x2 Crops)	Sugar	Net	Corn (x2 Crops)	Sugar	Net
Tasks involving carabaos (4 tasks)	25.0	9.3	+15.7	7.3	6.1	+ 1.2
Weeding by hand	27.3	13.7	+13.6	8.5	25.0	-16.5
Harvesting	3.1	0.6	+ 2.5	17.0	38.0	-21.0
Shelling, drying, hauling	5.0	0.0	+ 5.0	2.0	0.0	+ 2.0
Total			+36.8			-34.3

As a proportion of total labor inputs, harvesting is about twice as important for sugar production as it is for corn production. More than half of the increase in hired labor for sugar production is explained by this single-production step. Presumably because of time constraints in harvesting either of these crops, proportions of hired labor are high for both crops for this step, so that any differences in farmsize between corn and sugar households would explain only a small amount of the difference in absolute amounts of hired labor used.

Tasks involving carabaos explain 40 percent of the increase in the family labor requirement for corn production vis-à-vis sugar production. This is primarily due to use of carabaos for land preparation before planting for corn, while tractors are much more widely used for land preparation in sugar production (compare Tables 4.4 and 5.3). Again, use of tractors does not appear to be strongly related to farmsize, as sugar owner/renter and sugar renter household groups both use tractors extensively in sugar production, but hardly at all in corn production. Similarly in the case of postharvest processing, family labor requirements are higher for corn production, simply because the sugar technology provides no scope for use of family labor after harvesting is completed.

Interpretation of the allocation of family and hired labor between corn and sugar crops for weeding by hand is problematic in that for corn about three-fourths of total labor is provided by the family, while for sugar only about a third of total labor is provided for by the family. Table 6.5 shows a breakdown of total labor inputs for weeding by hand, along with the percentage supplied by the family

Table 6.5--Family days and hired labor days for weeding by hand for corn and sugar production, by selected crop and tenure group, by size of farm

Group	Corn (x2 Crops)		Sugar	
	Total	Percent Family	Total	Percent Family
Corn owners				
Large	33.1	61.3		
Small	35.8	75.1		
Corn owners/ tenants				
Large	21.9	68.5		
Small	51.8	93.8		
Corn share-tenants				
Large	28.2	77.7		
Small	31.0	82.3		
Sugar owners/ renters	23.0	47.8	35.1	5.4
Sugar owners	26.5	70.2	47.6	50.2
Sugar renters				
Large	46.6	74.0	19.6	33.7
Small	23.6	100.0	28.3	45.9
Total Sample	35.8	76.3	38.7	35.4

itself, for corn and sugar production for the the various crop, tenure, and size groups.

While there is some tendency for family labor inputs per hectare to decline with increasing farmsize for corn production, the only group that stands out as dramatically different from the other groups in terms of a low percentage contribution of family labor are the sugar owner/renter households. Comparing the percentage contributions of family labor across corn and sugar production for the sugar households, there is an obvious preference for family members to weed corn land as opposed to sugar land. Perhaps, this is related to the increasing difficulty of penetrating and being cut by the dense growth of sugarcane as the time after planting or ratooning increases.

To sum up, then, while the substitution of hired for family labor in switching from corn to sugar production is perhaps marginally overstated in Table 6.3 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.

MEN, WOMEN, AND CHILDREN PARTICIPATION RATES

Referring back to Table 6.3 once again, 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. As discussed above, this is primarily because of the decline in family weeding by hand, a task in which women participate heavily for corn production. Also, there are less dramatic declines

in harvesting and postharvest processing duties, in which the entire family takes part. Consequently, there is a reduction in children's labor in household production as well.

Women's participation in the hired labor force declines because sugar harvesting is such a large component of total labor demand, and this task is performed primarily by men in contrast with corn harvesting. However, the absolute decrease is not nearly as great as for household production, because demand for hired labor as a whole increases. We will see later in the analysis of women's time allocation that wives in sugar households reallocate the time they might have spent in own-farm and off-farm corn production, by working more than wives in corn households in nonagricultural jobs away from the house.

Finally, it appears that men (typically the heads of household) work far less time than before in household production activities with a switch to sugar production, a decline from 40.2 to 16.5 days per hectare. This is not entirely the case. Much of the implied "extra" time is spent in supervising hired laborers. Supervision time is not included in the data presented in these chapters, but is substantially higher for sugar than for corn.

OTHER SOURCES OF INCOME

Having dealt at some length in the last three chapters with a comparison of the corn and sugar production systems, the following chapters will address how incomes generated from the production of these crops are spent, and how time allocation and expenditure

decisions affect the nutrition of preschoolers within the household. Before proceeding, however, it is important to keep in mind that the sources of incomes for these households are extremely diverse, especially for households with access to land.

Table 6.6 shows the percentage distribution of various sources of income, disaggregated by income quintile and by crop and tenure group. For corn households with access to land, profits from corn production account for only about a third of total income, although this percentage share is larger than for any other single category presented in the table. A very similar pattern holds for sugar households with access to land and profits from sugar production.

For both crop groups with access to land, income from nonagricultural sources is the second most important component of income, contributing a quarter of the total. Backyard livestock, vegetable, and fruit production is a more important component of income for corn households with access to land than for sugar households, partly due to more livestock production, which is a complementary activity to corn production (see discussion of the disposition of corn production in Chapter 4).

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.

Table 6.6--Percent Allocation of Income by Income Quintile and by Crop Tenancy Group

Expenditure Group	Farm Production						Off-Farm			
	Sugar	Corn	Rice	Other Crop	Backyard	Total	Agricultural Wages	Non-Agricultural Wages, Business, Other	Total	Total
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
Corn owners	0	25	5	13	22	65	4	31	35	100
Corn mixed owners/ tenants	0	44	9	8	16	77	8	16	24	100
Corn share tenants	0	33	4	3	20	60	16	24	40	100
Corn laborers	0	6	0	1	17	24	65	11	76	100
Sugar	33	10	6	2	10	61	13	27	40	100
Sugar owners	42	12	5	3	9	71	3	26	29	100
Sugar mixed owners/ renters	33	8	10	2	9	61	2	36	38	100
Sugar renters	34	15	2	0	14	65	9	26	35	100
Sugar laborers	0	3	1	0	13	17	76	7	83	100

Landless laborer households, whether corn or sugar, are the most dependent on a single source of income, agricultural wages, which comprise from two-thirds to three-fourths of total income. For these households, backyard production, at roughly 20 percent, is the second largest component of income, higher even than nonagricultural wages, which account for only 10 percent of income.

7. INCOMES, EXPENDITURES, AND CALORIE INTAKES AT THE HOUSEHOLD LEVEL

INTRODUCTION

The previous three chapters have examined the corn and sugar production systems individually in some detail, and compared them with respect to profitability and labor allocation patterns. The next three chapters analyze how households in the various crop and tenure groups spend their incomes, derived in part from production of these crops, and how this expenditure behavior, in conjunction with time allocation patterns, affects nutrition.

The logic of the analysis will be to move from the aggregate to the disaggregate, from total household incomes to family food expenditures, then to household calorie intakes and intrahousehold distribution of those calories, and finally to the nutritional status of preschool children, as diagrammed in Figure 2.1 and specified in the four implicit equations given in Chapter 2. At each link along the way, we will be concerned with how certain variables, such as the education of each parent, nutritional knowledge of the mother, health and sanitation practices, and morbidity, condition the degree to which the potentially beneficial effects of increased income are transmitted to the heights and weights of preschoolers.

The immediate concern of this chapter is to determine the degree to which increases in household income translate into increased calorie

intakes at the household level. This includes two links in the four-step system outlined in Chapter 2. First, to what extent do increased incomes lead to higher food expenditures? Engel's law tells us that the budget share for food will decline with increasing income. What types of nonfood expenditures compete with food in household budget allocation decisions? Particular attention is given to expenditures for health expenses, which can indirectly improve nutritional status through decreased morbidity.

Second, to what extent do higher food expenditures lead to higher calorie consumption at the household level? According to Bennet's law, the share of starchy staples in the diet, usually the least expensive sources of calories, will decline with increasing food expenditures. What nonstaple foods have the highest income elasticities, and as a result of more variety in the diet, how quickly does the cost per calorie consumed rise with income?

ESTIMATING HOUSEHOLD INCOME, EXPENDITURES, AND CALORIE CONSUMPTION

In this chapter, three separate parts of the survey instrument are used to evaluate the relationship between household income and household calorie intakes. An extremely involved calculation is necessary for computing incomes from Blocks B through J (see Table 2.1), which cover all of the very diverse possible sources of incomes (summarized in Table 6.6) earned by our respondent households. Food and nonfood expenditures are taken from Blocks M and N, which asked respondents to recall food expenditures (by item from each source) for the past month and nonfood expenditures (by item) for the past four

months, using a variable time period recall method for items purchased more frequently than once a month (for food expenditures) or once every four months (for nonfood expenditures). Third, household calorie intakes are calculated from Block U, the 24-hour recall by the wife of foods consumed by individual household members.

Frequently, only expenditure data are collected for the type of analysis to be undertaken in this chapter, since it is obviously much less expensive and less time-consuming to exclude income and food intake data from any survey instrument. Adding food and nonfood expenditures gives total expenditures, a proxy for income which many researchers feel is a better measure of permanent income than income itself over the relatively short time period of one year. If quantities of particular foods are included in the food expenditure survey, this also gives an estimate of household calorie *availability*, which differs from household calorie *intake* (collected from the 24-hour food intake recall) by the amount of food which is purchased but not consumed by household members, for example, food that is wasted in storage and preparation.

Several questions could be raised here as to how these income, expenditure, and food intake data were collected, which data are more reliable, and how these variables should be related empirically. Some of these issues are discussed in Appendix 1. As concluded there, we feel that spurious correlation between total expenditures and total calorie availability, a consequence of overestimates of food expenditures by higher-income households, leads to overestimates of the relationship between rising income and calorie intakes. We, therefore,

prefer to use the income and calorie intake data in the regression analysis to follow. Nevertheless, as also discussed in Appendix 1, in presenting the survey data in several tables to follow, disaggregating by expenditure quintile is still to be preferred to disaggregating by income quintile.

Table 7.1 presents data for per capita income, total expenditures, food expenditures and per adult equivalent calorie availability, and calorie intakes disaggregated by income quintile, total expenditure quintile, and crop and tenure group. As expected, food budget shares decline with income and household calorie consumption increases. Although the incomes of corn share tenants seem to be especially underestimated, otherwise relative income and total expenditure levels across the crop and tenancy groups are in accordance with *a priori* expectations, households with more land, a higher tenancy status, and producing sugar having the higher incomes and expenditures.

NONFOOD EXPENDITURES

Table 7.2 summarizes weekly per capita expenditures for 14 nonfood groups along with their shares in the nonfood budget. As incomes rise, the most marked substitutions are away from fuel and light, cigarettes and alcohol, and nondurable household goods (detergent, matches, and fluid lighter) to housing (rent and repairs), semidurable household goods (furniture, dishes, lamps), transportation, household services (wages to helpers, launderers, drivers) and guest food expenses.

The percentage of the nonfood budget allocated to education (7.2 percent for all groups) and health expenses (6.4 percent for all

Table 7.1--Per capita income, total expenditures, food expenditures, food budget shares and per adult equivalent calorie availability and intakes by income group, expenditure group and by crop-tenancy group (1984 pesos per week per capita; calories per day)

Income Group	Income	Total Expenditures	Food Expenditures	Food Budget Share	Calorie Availability	Calorie Intake
1	14.1	29.9	23.9	0.80	2,155	2,260
2	23.9	35.9	26.2	0.73	2,215	2,309
3	32.5	40.3	28.9	0.72	2,361	2,331
4	45.6	48.3	33.5	0.70	2,635	2,418
5	108.9	75.3	42.9	0.57	2,778	2,415
All	44.9	45.9	31.1	0.68	2,429	2,346

Expenditure Group	Income	Total Expenditures	Food Expenditures	Food Budget Share	Calorie Availability	Calorie Intake
1	23.1	21.8	17.2	0.79	1,787	2,101
2	28.2	29.8	23.2	0.78	2,129	2,281
3	31.6	38.1	28.8	0.76	2,389	2,367
4	50.0	50.1	34.7	0.69	2,670	2,404
5	91.8	90.0	51.4	0.57	3,174	2,578
All	44.9	45.9	31.1	0.68	2,429	2,346

Crop-Tenancy Group	Income	Total Expenditures	Food Expenditures	Food Budget Share	Calorie Availability	Calorie Intake
Corn	38.1	41.4	29.3	0.71	2,375	2,372
Corn owners	51.7	49.2	32.7	0.66	2,445	2,387
Corn owners/tenants	50.2	46.6	30.4	0.65	2,368	2,329
Corn share tenants	30.7	40.0	29.6	0.74	2,405	2,412
Corn laborers	28.8	32.3	24.9	0.77	2,266	2,326
Sugar	56.5	53.5	33.7	0.63	2,534	2,343
Sugar owners	75.9	64.4	39.3	0.61	2,655	2,386
Sugar owners/renters	90.3	89.9	47.5	0.53	3,148	2,447
Sugar renters	46.5	43.5	30.0	0.69	2,350	2,371
Sugar laborers	28.7	30.8	24.0	0.78	2,208	2,237

Table 7.2--Weekly per capita nonfood group expenditures and shares of total expenditure by per capita total expenditure quintile, all rounds (Round 1 - constant pesos)

	Total Expenditure Quintile					
	1	2	3	4	5	All
1. Housing	0.08	0.18	0.31	0.33	3.76	0.93
	(1.8)	(2.8)	(3.3)	(2.1)	(9.8)	(6.3)
2. Fuel & Light	0.68	0.81	0.94	1.08	1.83	1.07
	(15.0)	(12.4)	(10.0)	(7.0)	(4.8)	(7.2)
3. Clothing/Textile/Footwear	0.61	0.96	1.36	2.28	4.60	1.96
	(13.4)	(14.7)	(14.4)	(14.8)	(12.0)	(13.2)
4. Nondurable Household Goods	0.58	0.70	0.86	1.07	1.26	0.89
	(12.8)	(10.7)	(9.1)	(7.0)	(3.3)	(6.0)
5. Semidurable Household Goods	0.05	0.08	0.17	0.20	1.41	0.38
	(1.1)	(1.2)	(1.8)	(1.3)	(3.7)	(2.6)
6. Personal Care/Effects	0.12	0.17	0.33	0.72	1.70	0.61
	(2.6)	(2.6)	(3.5)	(4.7)	(4.4)	(4.1)
7. Household Services	0.00	0.02	0.00	0.08	1.40	0.30
	(0.0)	(0.3)	(0.0)	(0.5)	(3.6)	(2.0)
8. Health Expenses	0.29	0.35	0.65	0.96	2.52	0.95
	(6.4)	(5.4)	(6.9)	(6.2)	(6.5)	(6.4)
9. Education	0.39	0.44	0.73	1.20	2.54	1.07
	(8.6)	(6.7)	(7.7)	(7.8)	(6.6)	(7.2)
10. Public/Private Transport	0.23	0.48	0.60	1.05	5.65	1.60
	(5.1)	(7.3)	(6.4)	(6.8)	(14.7)	(10.8)
11. Recreation/Entertainment/ Family Events	0.38	0.56	0.90	1.39	2.91	1.22
	(8.4)	(8.6)	(9.5)	(9.0)	(7.6)	(8.2)
12. Cigarettes/Alcohol	0.73	1.08	1.55	2.45	3.16	1.79
	(16.1)	(16.6)	(16.4)	(15.9)	(8.2)	(12.1)
13. Guest Food Expenses	0.36	0.66	0.96	2.41	4.68	1.81
	(7.9)	(10.1)	(10.2)	(15.7)	(12.2)	(12.2)
14. Communication/Taxes/ Miscellaneous	0.04	0.04	0.07	0.15	1.06	0.27
	(0.9)	(0.5)	(0.7)	(0.9)	(2.8)	(1.8)
Nonfood Expenditures	4.54	6.52	9.43	15.37	38.62	14.85
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

groups) remains almost constant across income groups. Direct estimations of the income elasticites for selected nonfood groups (not shown) classify health (income elasticity of 1.4), but not education (income elasticity of 0.7), as a luxury good. Father's years of education has a significant, positive effect on both health and education expenses, while mother's years of education does not have a significant effect for either health or education expenses.

Table 7.3 shows per capita expenditures for selected nonfood categories disaggregated by crop and tenure group. Again, the expected patterns emerge as households with more land, a higher tenancy status, and producing sugar spend more for these nonfood items. However, some differences in expenditure behavior across crop tenancy groups is evident even controlling for income. For example, corn owner/renter households spend considerably more for housing than the corn owner households, despite a slightly lower average income. Corn owner households spend the same on housing as the sugar owner households, despite having lower incomes.

Corn owner/renter, share tenant, and laborer households seem to be spending less on health expenditures than the corresponding sugar renter and laborer groups, which have about the same levels of income. We will see later in Chapter 9 that preschoolers in sugar households are sick more frequently than preschoolers in corn households. Health expenditures are especially difficult to interpret. Further disaggregation of health expenditures into preventative versus curative is desirable but unavailable. One would expect the preventative component to play a larger role in the health budget as incomes increase.

Table 7.3--Non-food expenditures for selected categories by expenditure quintile by crop-tenancy group

Expenditure Group	Total	Health	Education	Housing	Clothing	Transportation
1	4.54	0.29	0.39	0.08	0.61	0.23
2	6.52	0.35	0.44	0.18	0.96	0.48
3	9.43	0.65	0.73	0.31	1.36	1.60
4	15.37	0.96	1.20	0.33	2.28	1.05
5	38.62	2.52	2.54	3.76	4.60	5.65
All	14.85	0.95	1.06	0.93	1.96	1.60
Crop-Tenancy Group						
Corn	12.08	0.62	0.78	0.91	1.77	0.79
Crop owners	16.46	1.05	1.29	1.17	2.52	1.11
Corn owners/ tenants	16.26	0.60	1.19	1.97	2.36	1.00
Corn share tenants	10.46	0.47	0.66	0.70	1.62	0.66
Corn laborers	7.40	0.51	0.19	0.13	0.85	0.54
Sugar	19.78	1.41	1.62	1.14	2.30	3.05
Sugar owners	25.13	1.88	3.27	1.16	3.51	2.23
Sugar owners/ renters	42.39	2.87	2.39	3.68	3.73	10.70
Sugar renters	13.50	0.77	1.13	0.52	1.84	1.32
Sugar laborers	6.76	0.60	0.21	0.08	0.86	0.41

Sugar landowners spend a third more on education than do the sugar owner/renter households, a high proportion of whose higher incomes are going for private transportation expenses. However, it should be remembered that these two-way tables hide many confounding variables. More may be spent on education in the landowner households simply because they are likely to have more children in the 5 to 15 age group.

FOOD EXPENDITURES BY SOURCE

Table 7.4 gives the percentage distribution of food expenditures broken down by whether foods were purchased in the market, grown by the household itself, earned as in-kind wages, or were received either as gifts or loans. Sugar households purchase an average of about 15 percent more of their food in market than do corn households, a result which is invariant to tenure status. Conversely, about 15 percent more of corn household food purchases come from their own production. This is not invariant to tenure status, as households with access to more land, not surprisingly, 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 shown in Table 7.4, can be explained by differences between the two groups in their purchases of rice and corn, the two main staples. Comparing like tenure groups across crops, Table 7.5 shows that all sugar tenure groups spend more for rice, and that all corn tenure groups spend more for corn. Because a relatively high proportion of corn is home produced, on average corn

Table 7.4--Percent allocation of weekly per capita food expenditures by source by expenditure quintile and by crop tenancy group

Expenditure Group	Purchased	Home Produced	In-Kind Wages	Gifts/ Borrowed	All
1	43	41	12	4	100
2	49	38	9	4	100
3	52	38	7	3	100
4	57	35	5	3	100
5	64	32	1	2	100
All	56	36	6	3	100
Crop-Tenancy Group					
Corn	47	43	7	3	100
Corn owners	44	52	2	2	100
Corn owners/tenants	48	47	3	2	100
Corn share tenants	48	43	5	4	100
Corn laborers	49	29	18	4	100
Sugar	63	30	5	3	100
Sugar owners	61	36	1	2	100
Sugar owners/renters	65	32	1	2	100
Sugar renters	60	32	6	2	100
Sugar laborers	64	17	13	6	100

Table 7.5--Per capita corn and rice expenditures by source by crop and tenancy group

Expenditure Group	Corn Expenditures					Rice Expenditures				
	Total	Purchased	Home Produced	In-Kind Wages	Gifts/ Borrowed	Total	Purchased	Home Prod.	In-Kind Wages	Gifts/ Borrowed
1	7.47	2.07	4.04	1.34	0.02	3.03	1.00	1.12	0.75	0.17
2	8.77	2.36	5.15	1.21	0.06	4.29	2.07	1.08	1.01	0.13
3	8.63	2.26	5.00	1.30	0.06	6.03	2.76	2.17	0.94	0.17
4	9.01	2.14	6.05	0.79	0.03	6.88	3.47	2.03	1.14	0.23
5	5.69	1.45	4.02	0.20	0.01	13.36	7.13	5.76	0.36	0.12
All	7.92	2.06	4.86	0.97	0.04	6.70	3.27	2.42	0.84	0.17
Crop-Tenancy Group										
Corn	8.78	1.76	5.98	1.01	0.03	5.35	2.15	2.14	0.95	0.11
Corn Owner	9.20	1.12	7.71	0.37	0.00	5.56	2.11	3.11	0.23	0.10
Corn Owner/Renter	7.64	1.05	6.16	0.42	0.01	6.19	2.52	3.00	0.64	0.03
Corn Share Tenant	9.09	1.95	6.45	0.66	0.03	5.07	2.17	1.81	0.96	0.13
Corn Laborer	8.81	2.61	3.42	2.72	0.07	4.94	1.81	1.10	1.86	0.16
Sugar	6.75	2.56	3.16	0.99	0.05	8.72	4.95	2.89	0.67	0.21
Sugar Owner	6.35	1.77	4.28	0.25	0.06	10.04	5.48	4.33	0.18	0.04
Sugar Owner/Renter	4.83	1.20	3.41	0.19	0.03	14.12	7.72	5.89	0.18	0.33
Sugar Renter	7.59	2.45	4.12	1.00	0.02	6.81	3.82	2.33	0.65	0.01
Sugar Laborer	7.64	3.98	1.61	1.98	0.07	5.81	3.65	0.44	1.32	0.39

households make market cereal purchases of only ₱3.91 per capita compared to ₱7.51 for sugar households. Corn households, on the other hand, consume ₱8.12 worth of home-produced cereals, compared to ₱6.05 for sugar households. These numbers indicate a net increase of ₱3.60 in market purchases of cereals for sugar households, which is about 12 percent of the total sample average for per capita food expenditures of ₱31.10.

Prices paid for corn grits and rice do not vary by income group. Therefore, the breakdown of corn and rice expenditures at the top of Table 7.5 by expenditure group is a good indication of the pattern of consumption of rice and corn across income groups. Regressions (not shown) indicate that the income elasticity for corn is slightly negative at middle income levels (although positive for lower income groups) and that the income elasticity for rice is somewhat above 1.0. An F-test indicates that the marginal propensity to consume rice out of income is significantly higher for sugar households than for corn households.

ESTIMATING THE EFFECT OF INCOME ON FOOD EXPENDITURES

To review the procedure for estimating each of the four links (outlined in Chapter 2) that determine how increases in income affect nutrition, first a test is run for simultaneity of a right-hand side variable with the dependent variable, using the whole sample (which consists of all agricultural households, including the corn "other rent" households, but excluding the "other occupation" households). If simultaneity is found, the right-hand side variable is replaced by a

two-stage least squares estimate before proceeding. Next, the desired equation is estimated for the whole sample and for a subsample of corn households (excluding the corn "other rent" households) and a subsample of sugar households. An F-test is then conducted (this involves running a fourth regression) which tests the null hypothesis that all coefficients between the two sub-samples are equal, with the exception of the intercept term which is allowed to vary.

In the first equation of the four equation system to be estimated, food expenditures are the dependent variable and per capita income is tested for simultaneity with food expenditures. Income is found to be simultaneously determined with food expenditures (i.e., consumption decisions influence production decisions; for example, the fact that a household can save a 25 percent premium by growing its own corn influences what crops that household grows), and income is replaced with a two-stage least squares estimate, using total cultivated area per capita as the identifying variable. Land availability is assumed to be a constraint and so exogenous to the household decisionmaking process in the short run. The results of estimating this first equation are given in Table 7.6.

The coefficients on the linear and squared income terms are positive and negative, respectively, as expected, and both are highly significant for all three samples. As the number of household members increases, *per capita* food expenditures go down indicating some economies of scale. These economies of scale improve with higher income, as indicated by the negative term on household size multiplied by income. Estimated at mean income levels, the marginal propensities

Table 7.6--Regression results where the dependent variable is food expenditures per capita per week

	All Households	Corn Households	Sugar Households
(Constant)	21.99921 (5.83)	18.93895 (3.87)	27.76226 (4.19)
PREDINC	.48610 (11.62)*	.66410 (8.05)*	.40463 (6.84)*
PINCSQ	-1.07x10-3 (-7.10)*	-4.13x10-4 (-0.74)	-9.40x10-4 (-4.78)*
PYNUMRD	-.01407 (-4.25)*	-.05612 (-5.42)*	-.00608 (-1.46)
NUMRD	-.61242 (-3.04)*	.71275 (1.92)	-1.13800 (-3.34)*
MEANAGE	.01044 (1.78)	.00285 (0.42)	.02287 (1.90)
PRCORN	.21209 (0.36)	-.34117 (-0.59)	.66716 (0.62)
PRRICE	-1.67317 (-3.47)*	-1.47488 (-2.43)*	-3.23790 (-3.80)*
PCTHOME	-.02469 (-1.86)	-.02441 (-1.43)	-.01718 (-0.70)
AVNETWTH	8.90x10-5 (2.83)*	11.69x10-5 (3.01)*	6.05x10-5 (1.37)
FATHED	-.07525 (-0.54)	.16994 (0.94)	-.18422 (-0.80)
WIFEED	.51377 (3.50)*	-.14209 (-0.74)	1.34383 (5.42)*
RD1	3.57178 (3.90)*	4.51101 (4.03)*	1.26819 (0.79)
RD2	.73268 (.71)	2.69186 (2.11)*	-2.75521 (-1.57)
RD3	1.57392 (1.57)	1.31706 (1.07)	1.65498 (.95)
	R-Square = .393 F = 74.29 N = 1624	R-Square = .311 F = 29.42 N = 928	R-Square = .478 F = 39.88 N = 624
Marginal expenditure for food	0.29	0.24	0.25
Food expenditure elasticity with respect to income	0.42	0.32	0.42

Note: T-statistics in parentheses.
* Significant at 5 percent level.

Variable Labels:

PREDINC = predicted income from two-stage least squares, peso per capita per week
PINCSQ = square of predicted income
PYNUMRD = predicted income times household size
NUMRD = household size
MEANAGE = average age of household members
PRCORN = quality adjusted real price of corn
PRRICE = quality adjusted real price of rice
PCTHOMEP = percentage of food expenditures coming from own-farm production
AVNETWTH = average net worth of all household assets
FATHED = years of formal education of the father
WIFEED = years of formal education of the mother
RD1,RD2,RD3 = zero-one round dummy variables

to spend an additional peso of income on food are 29 centavos for the whole sample, 24 centavos for corn households, and 25 centavos for sugar households. The corresponding elasticities are 0.42, 0.32, and 0.42.

While the magnitudes of these marginal propensites and elasticities are reasonable taken individually, a troubling aspect of their relative magnitudes is that the estimates for sugar households are somewhat higher, even though sugar households have higher incomes. In part, this may be because sugar households purchase more rice which is more expensive than corn, and in general buy a higher proportion of their food in the market. However, a more plausible explanation is the bias introduced in the estimates by the overestimation of food expenditures by higher-income sugar households (see the discussion in Appendix 1), which give a somewhat biased impression of rapidly rising food expenditures (in absolute terms) as income increases.

Turning to other variables in this first equation, for the whole sample the wife's years of education are positive and significant, as is average net worth. For the subsample regressions, wife's education is significant only for sugar households, while average net worth is significant only for corn households. Raising rice prices significantly lowers food expenditures, indicating substitution to corn which is less expensive. As would be expected given the cereal consumption patterns shown in Table 7.5, this effect is stronger in sugar households than it is in corn households, although significant for both subsamples.

The test for equality of coefficients across corn and sugar households gave an F-value of 4.26, which is well above the critical value. Given the change in demand preferences for rice and corn and differences in market participation rates, this comes as no surprise. However, a troubling aspect of this test continues to be the unknown extent to which it is influenced by the over-estimate of food expenditures by higher-income sugar households.

CONVERSION OF FOOD EXPENDITURES INTO CALORIE INTAKES

The second link in the four-step process is to measure the extent to which increased food expenditures translate into increased calorie intakes at the household level. Table 7.7 shows the average number of calories purchased per peso disaggregated by expenditure quintile and by crop tenancy group. 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. Table 7.7 indicates that highest income quintile households, given their particular basket of food purchases, have to spend 60 percent more than the lowest income quintile households just to consume the same amount of calories. Comparing calories purchased per peso by the various crop and tenancy groups within columns in Table 7.7, that is controlling for income, there are no noticeable differences between these groups.

Table 7.8, which disaggregates food expenditures by five broad food groups, indicates what types of calorie-expensive foods higher income groups in our sample demand. Overwhelmingly, it is the meat

Table 7.7--Calories purchased per peso, by crop tenancy group by total expenditure quintile, all rounds

Crop-Tenancy Group	Expenditure Quintile 1	2	3	4	5	ALL
Corn	526	470	440	401	329	442
Corn landowners	508	487	427	389	333	413
Corn mixed tenancy	489	445	426	389	335	413
Corn share tenancy	528	483	442	418	318	449
Corn laborers	521	454	460	425	356	476
Sugar	522	457	443	397	320	416
Sugar landowners	482	455	459	419	316	387
Sugar mixed tenancy	-	456	430	407	314	349
Sugar renters	523	479	404	372	332	424
Sugar laborers	531	448	436	380	321	468
All	521	466	434	397	320	428

Table 7.8--Percent allocation of weekly per capita food expenditures by broad food group by income quintile by crop tenancy group

Expenditure Group	Staples	Meat Eggs/Fish	Vegetables, Legumes	Fruits, Snacks Dessert, Beverages	Cooking Ingredients	All
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
Corn owners	45	31	4	13	7	100
Corn mixed owners/tenants	47	31	5	9	8	100
Corn share tenants	50	29	5	9	8	100
Corn laborers	56	23	5	9	7	100
Sugar	46	31	5	10	7	100
Sugar owners	42	35	5	11	7	100
Sugar mixed owners/renters	40	36	5	12	7	100
Sugar renters	48	30	6	10	7	100
Sugar laborers	56	24	5	9	7	100

category which increases its share with income, as the staple share declines. The shares of the remaining three food groups remain nearly constant with rising income.

Before estimating the relationship between household calorie intake and food expenditures (shown in Table 7.9), the exogeneity of food expenditures was tested and could not be rejected. In Table 7.9, the expected quadratic relationship between per capita food expenditures and household calorie intake per adult equivalent is indicated by the significantly positive and negative coefficients, for all three samples, on the linear and squared food expenditure terms, respectively. No education variables were significant in any of the regressions, nor was a variable measuring the nutritional knowledge of the mother (this variable is discussed later in Chapter 9). The only variable in addition to food expenditures that was signficant was the municipality population density, intended as a proxy for the availability of processed and packaged foods in the local market. The sign on this variable is negative (as expected) and significant for both corn and sugar households.

Testing for the equality of coefficients across groups, an F-value of 0.79 does not reject the null hypothesis. At the margin at mean levels, each extra peso expenditure for food (per capita) per week, increased household calorie intake by about 13 calories (per adult equivalent) per day for corn households, and by about 16 calories per day for sugar households. The corresponding figure for the whole sample was 14 calories. These translate into elasticities of 0.18 for

Table 7.9--Regression results where the dependent variable is household calorie intake per adult equivalent per day

	All Households	Corn Households	Sugar Households
(Constant)	2427.50204 (19.82)	2346.22712 (12.97)	2652.58464 (14.05)
FFEXWKPC	20.58697 (6.65)*	19.04509 (3.79)*	23.79189 (5.69)*
FFEXSQ	-.10694 (-3.66)*	-.10029 (-1.90)	-.12172 (-3.36)*
FATHED	-10.24724 (-1.45)	-10.10937 (-0.97)	-10.01697 (-1.00)
WIFEED	-2.75586 (-0.35)	7.73537 (0.68)	-13.37948 (-1.07)
NUTRSC1	7.89920 (1.35)	9.64585 (1.25)	2.98571 (0.31)
MEANAGE	-.06349 (-0.21)	.01541 (0.04)	-.54602 (-1.00)
NUMRD	-30.42134 (-4.50)*	-32.78314 (-3.31)*	-27.59213 (-2.76)*
POPDEN	-2.11574 (-5.36)*	-1.76430 (-3.17)*	-2.89920 (-4.57)*
RD1	140.24014 (2.82)*	187.74822 (2.72)*	87.99793 (1.18)
RD2	-41.97581 (-0.85)	-74.00092 (-1.08)	1.51177 (0.02)
RD3	-158.27376 (-3.20)	-166.58989 (-2.43)*	-169.45401 (-2.27)*
	R-Square = .118 F = 19.64 N = 1624	R-Square = .113 F = 10.57 N = 928	R-Square = .160 F = 10.62 N = 624
Household calorie intake elasticity with respect to food expenditures	0.18	0.16	0.22

Note: T-statistics in parentheses.
* Significant at 5 percent level.

Variable Labels:

FFEXWKPC = household food expenditures per week per capita
FFEXSQ = household food expenditure per week per capita squared
FATHED = years of formal education of the father
WIFEED = years of formal education of the mother
NUTSCR1 = measure of nutritional knowledge ofthe mother
MEANAGE = average age of household members
NUMRD = household size
POPDEN = population density of municipality
RD1,RD2,RD3 = zero-one round dummy variables

the whole sample, 0.16 for corn households, and 0.22 for sugar households.

CONCLUSION

The expenditure behavior indicated by the regression results presented in this chapter reveals a high degree of leakage between higher incomes and increases in calorie intakes at the household level. Multiplying the elasticities estimated from the two regressions gives the percentage change in household calorie intake per adult equivalent over the percentage change in income, 0.08 for the whole sample, 0.05 for corn households, and 0.09 for sugar households. Rather than concentrate on the relatively higher elasticity for sugar households (partly due to technical questions raised above and in Appendix 1 about the sugar household food expenditure data), the striking conclusion is that as incomes double, household calorie intakes increase by less than 10 percent for both corn and sugar households. Raising incomes would appear to be an extremely inefficient way of raising calorie intakes.

This empirical result does not appear to be an artifact of the econometric techniques used, or of extreme outlier observations. The magnitudes reported here are in close correspondence with those reported in Appendix 1, which attempts a rough calculation of the same elasticity from the data in Table 7.1. Because actual income data were used which includes savings, if higher-income groups save a higher proportion of their income than do low-income groups, an elasticity based instead on total expenditures (which are more typically used to estimate the relationship between income and household calorie consump-

tion) would be marginally higher than those reported here, as a basis of comparison with other studies. Even then, an upper bound estimate would perhaps be 0.10.

From a narrow nutritional point of view, such expenditure behavior would still be rational under either of two conditions: first, if the recommended calorie intake levels of all household members were already being met at low levels of income, *or* second, if raising the calorie intakes of low-calorie-intake individuals had no perceptible effect on nutritional status (weight, height) because of other external factors, such as high morbidity rates. As the following two chapters will show, neither of these conditions holds for our sample respondents. Rather, the most plausible explanation for this expenditure behavior would appear to be a mistaken perception that the first condition holds.

8. INDIVIDUAL CALORIE INTAKES

INTRODUCTION

In the previous chapter, the factors affecting household-level food expenditure decisions were examined. In this chapter, we look at how the aggregate food bundle is distributed among individual household members. Calorie intakes for various age groupings are presented and compared across expenditure and crop tenancy groups. Regression analysis identifies and measures the relative influences of the various determinants of individual calorie intakes for preschool children.

The analysis will show a general pattern of maldistribution of calories within households that favors adults at the expense of children, who on average are consuming well below their recommended daily intakes. This pattern improves only marginally as incomes rise, suggesting that parents may not be aware that their preschoolers are not consuming sufficient calories. However, at low-income levels there is evidence of serious competition between parents and children for consumption of scarce household calories, as parents face the difficult tradeoff of providing sustenance for their children, as well as for their own energy needs in undertaking the strenuous work of earning income.

AVERAGE CALORIE ADEQUACY RATIOS

Table 8.1 presents average calorie adequacy ratios for various age groupings by expenditure group and by 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 apppropriate age and sex. Only preschoolers for whom breastfeeding has already been stopped (as will be discussed in Chapter 9 over 90 percent of preschoolers in our sample were breastfed) are included in the table, because data were not collected on calorie intake from breastmilk. Consequently, currently breastfed children were also excluded from the regressions reported on below and in Chapter 9.

The recommended calorie intakes assume a moderate level of activity. Because actual activity levels were not recorded, the numbers presented in Table 8.1 need to be treated with some caution. However, this is much less of a problem for preschoolers than adults. If we assume that the activity levels of low-income adults are higher than high-income adults, then the calorie adequacy ratios for low-income adults will tend to overstate their calorie adequacy ratios relative to calorie adequacy ratios of high-income adults.

Table 8.1 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. What is even more discouraging from the point of view of preschooler nutrition is that at the margin, the absolute increase in calories per adult equivalent is slightly higher for adults than preschoolers, although the percentage

Table 8.1--Average calorie adequacy ratio and percent falling below 80 percent of caloric requirements by type of family member by expenditure quintile and by crop tenancy group

Expenditure Quintile	Average Calorie Adequacy Ratio					Percent Falling Below 80% of Caloric Requirement				
	Preschoolers (0-4)	Children (5-14)	Adolescents (>14)	Mothers	Fathers	Preschoolers (0-4)	Children (5-14)	Adolescents (>14)	Mothers	Fathers
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
Corn owners	0.82	0.78	0.89	1.19	1.10	56	56	33	15	18
Corn owner/tenants	0.73	0.77	0.82	1.15	1.05	67	57	46	23	24
Corn share tenants	0.77	0.76	0.89	1.11	1.05	61	58	36	19	22
Corn 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
Sugar owners	0.74	0.80	0.91	1.13	1.12	65	56	33	18	17
Sugar owner/renters	0.76	0.77	0.91	1.15	1.15	61	53	35	13	15
Sugar renters	0.71	0.76	0.82	1.13	1.13	67	60	42	19	13
Sugar laborers	0.71	0.70	0.75	1.03	1.04	66	63	53	26	23

increase is slightly better for preschoolers than adults. The extra calories available to higher income households are not going disproportionately to preschoolers, despite their being below recommended daily intakes.

Comparing calorie adequacy ratios across the various crop tenancy groups, preschoolers in corn households seem to do marginally better than in sugar households. While the difference is not large, it is still surprising in view of the higher incomes in sugar households. Preschoolers and mothers in corn owner households do especially well, relative to other groups.

Table 8.1 also shows the percent of respondents falling below 80 percent of their recommended daily calorie intakes. The absolute percentages mean little in the sense that there is wide variation in the daily intakes of even adequately-fed individuals, who on some days will consume below required levels. However, comparing these percentage figures across expenditure levels and age groups, they reflect, for the most part, the same pattern as the average calorie adequacy ratios. Preschoolers have much higher percentages of respondents falling below 80 pecent of requirements than do adults, and these preschooler percentages do not improve much with income.

MORBIDITY AND APPETITE

A possible explanation for the low preschooler calorie intakes is a loss in appetite due to sickness. Morbidity data are discussed in more detail in the following chapter, but Table 8.2 shows that preschoolers who were sick in the two weeks prior to each survey round

Table 8.2--Preschooler calorie intakes by whether preschooler was sick with any symptom in the past two weeks, by whether had a fever, and by whether had diarrhea

Symptom	Preschooler Calorie Intake Per Adult Equivalent
Sick	
Yes	1,821
No	1,979[a]
Fever	
Yes	1,775
No	1,968[a]
Diarrhea	
Yes	1,669
No	1,943[a]

[a] Significantly different at 1 percent level for one-tailed T-test.

had significantly lower calorie intakes per adult equivalent than children who were not sick. Regression results presented below estimate that preschooler calorie intake per adult equivalent goes down about 91 calories for every incidence of sickness. This is less than four percent of the daily requirement, so that factors other than sickness account for the low intakes.

ESTIMATING THE DETERMINANTS OF PRESCHOOLER CALORIE INTAKES

Table 8.3 presents the regression estimates for the third link in the four-step process outlined in Chapter 2, the determinants of preschooler calorie intake. Counting each preschool child in each household in each round as one observation, a total of 2,278 preschool observations were recorded. Of these, some 415 were being breastfed at the time of interview, leaving 1,863 cases. Missing data for 13 other variables further reduced the number of observations available for regression analysis to 1,689.

In estimating the determinants of preschooler calorie intakes, the intakes of the father's and mother's calories, along with household calories (all four calorie intake variables are expressed in terms of adult equivalencies), are included to test for competition between parents and preschoolers for scarce household calories. Mother's, father's, and household calories were all tested individually for simultaneity with preschooler calorie intakes and the null hypothesis of exogeneity was not rejected for all three variables. This implies that parents have first claim in the intrahousehold distribution of

Table 8.3--Regression results where the dependent variable is preschooler calorie intake per adult equivalent per day

	All Households		Corn Households		Sugar Households	
Constant	-1614.92127	(-10.71)	-1775.38939	(-9.11)	-1265.76048	(-4.92)
HCALAEQ	1.70949	(41.71)*	1.81005	(36.15)*	1.48164	(19.15)*
FCALAEQ	-.41289	(-16.98)*	-.43686	(-13.58)*	-.33651	(-8.36)*
MCALAEQ	-.30559	(-13.89)*	-.34409	(-12.62)*	-.24226	(-5.87)*
FATHED	.94696	(0.16)	-7.43220	(-0.93)	13.93322	(1.45)
WIFEED	10.64179	(1.54)	21.40161	(2.36)*	-5.31655	(-0.44)
AGEMOM	.96276	(3.86)*	1.05253	(3.16)*	.66712	(1.64)
CHILDCRE	.29230	(2.08)*	.40724	(2.33)*	.08642	(0.34)
NUTRSC1	-2.74577	(-0.56)	-10.29869	(-1.73)	13.12376	(1.39)
SICK	-91.37252	(-2.72)*	-95.35929	(-2.22)*	-78.81652	(-1.39)
ACCAGE	47.28514	(7.69)*	51.84895	(6.33)*	36.14392	(3.64)*
AGESQ	-.55853	(-6.79)*	-.61940	(-5.71)*	-.39464	(-2.92)*
SEX	65.33479	(2.16)*	60.70948	(1.59)	66.99961	(1.28)
ADEQVHH	38.41637	(3.74)*	47.70048	(3.23)*	25.79957	(1.69)
	R-Square =	.615	R-Square =	.675	R-Square =	.502
	F =	205.87	F =	158.08	F =	47.33
	N =	1689	N =	1003	N =	624
Individual calorie intake elasticity with respect to household calories		1.21		1.23		1.14

Note: T-statistics in parentheses.
* Significant at 5 percent level.

Variable Labels:

HCALAEQ = household calorie intake per adult equivalent per day
FCALAEQ = father's calorie intake per adult equivalent per day
MCALAEQ = mother's calorie intake per adult equivalent per day
FATHED = years of formal education of the father
WIFEED = years of formal education of the mother
AGEMOM = mother's age in months
CHILDCRE = minutes spent by mother in childcare in previous 24 hours
NUTRSC1 = measure of nutritional knowledge of the mother
SICK = zero-one dummy for reporting sickness in previous two weeks
ACCAGE = age of preschooler in months
AGESQ = age of preschooler squared
SEX = 0=female, 1=male
ADEQVHH = number of household members expressed in adult equivalents

calories. The morbidity variable was also tested for simultaneity with preschooler calorie intakes and was found to be exogenous.

For all three samples, the household calorie intake was found to be a positive and significant determinant of preschooler calorie intake. Negative coefficients on mother's calories and father's calories imply that, controlling for the level of household calorie intake, the more calories that mothers and fathers consume, the less that preschoolers consume.

Assuming that at the margin, as household calorie intake goes up one calorie per adult equivalent, mother's and father's calorie intakes also go up by one calorie per adult equivalent (i.e., that the derivative of mother's and father's calorie intakes with respect to household calorie intake is one; regressions [not shown] with father's and mother's calorie intakes as dependent variables indicate that this assumption is a reasonable approximation), then the marginal increase in preschooler calorie intakes for every one calorie increase in household calorie intake is the sum of the three coefficients on mother's, father's, and household calorie intakes, which for the whole sample is 0.99. This would mean that, at the margin at least, calories were being distributed equitably among various household members, even though on average preschooler calorie intakes are lower than parental calorie intakes. Making this same computation for the subsample regressions, values of 1.03 and 0.90 are obtained for the corn and sugar households, respectively, implying a somewhat more equitable distribution of calories in the corn households.

Years of education of either parent and the nutritional knowledge of the mother were all insignificant determinants of preschooler calorie intakes for the whole sample, although mother's education was significant for the corn household subsample. The age of the mother was included as a proxy for her experience in child rearing. This turned out to be positive and significant for the whole sample and the corn household subsample. The same pattern occurred for time spent by the mother in childcare, intended as an indicator of the attention which individual mothers were able to give to their preschool children.

In all three regressions, the older preschoolers received closer to their daily recommended intakes of calories than did younger preschoolers. For the whole sample, the positive and significant coefficient on a dummy variable for sex indicates that boys received more calories than did girls.

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 significance of this particular result will be postponed until Chapter 9, in connection with the analysis of the differences in mother's time allocation patterns between corn and sugar households.

REGRESSIONS BY CROP TENANCY GROUP

To further explore the issue of competition for calories between parents and preschoolers, separate regressions were run for each of eight crop tenancy groups. Given the significant coefficients on mother's and father's calories for the whole sample, a working hypo-

thesis would be that there is less competition in the higher income households than in lower income households. The estimating equations were specified exactly as those reported in Table 8.3, although Table 8.4 summarizes the results of these additional regressions only for selected variables.

The coefficients and t-statistics on mother's and father's calories indicate that competition for calories is most significant for the low-income, landless laborer households for each crop. Moreover, within each crop, the coefficients and t-statistics rise almost monotonically with the income level of the four tenure groups. The coefficients on father's calories are higher than for mother's calories for all eight groups. Only for mother's calories for the two highest income groups (sugar owners and owner/renters) are the coefficients not significant. Note for corn households as the competition for calories increases with declining income, how the years of wife's education and childcare time become increasingly important ameliorating effects in increasing preschooler calorie intakes.

CONCLUSION

In Chapter 7, income elasticities of household calorie intakes were estimated to be 0.08, 0.05, and 0.09 for the whole sample, corn households, and sugar households, respectively. Converting the marginal rates of increases in preschooler intakes with respect to increases in household calorie intakes (reported above) to elasticities gives elasticities of 1.21, 1.23, and 1.14. Multiplying these two sets of elasticities together gives the percentage increase in

Table 8.4--Selected coefficients for preschooler calorie intake regressions run separately for each crop tenancy group

	FCALAEQ	MCALAEQ	WIFEED	CHILDCRE	SICK
Corn owners	-0.483 (-6.5)	-0.262 (-3.3)	18.90 (0.8)	-1.024 (-1.9)	-0.0 (-0.0)
Corn owners/tenants	-0.305 (-3.9)	-0.191 (-3.3)	40.57 (1.4)	0.159 (0.4)	28.8 (0.3)
Corn share tenants	-0.403 (-7.5)	-0.325 (-6.2)	14.85 (0.9)	0.544 (2.0)	-135.1 (-1.9)
Corn laborers	-0.611 (-9.8)	-0.538 (-11.7)	41.78 (2.4)	0.914 (2.5)	-164.4 (-1.9)
All Corn	-0.437 (-13.6)	-0.344 (-12.6)	21.40 (2.4)	0.407 (2.3)	-95.4 (-2.2)
Sugar owners	-0.303 (-3.4)	-0.174 (-1.5)	-28.41 (-0.9)	-0.071 (-0.1)	-133.5 (-1.0)
Sugar owners/renters	-0.250 (-2.6)	-0.145 (-1.5)	-29.02 (-1.0)	0.142 (0.2)	-180.7 (-1.5)
Sugar renters	-0.390 (-4.2)	-0.223 (-2.6)	9.77 (0.4)	1.105 (2.2)	-115.8 (-0.9)
Sugar laborers	-0.465 (-6.9)	-0.382 (-5.7)	23.06 (1.1)	-0.387 (-0.9)	40.2 (0.4)
All Sugar	-0.337 (-8.4)	-0.242 (-5.9)	-5.32 (-0.4)	0.086 (0.3)	-78.8 (-1.4)

Note: T-statistics in parentheses.

preschooler intakes over the percentage increase in incomes, or 0.10, 0.06, and 0.11 for the whole sample, corn households, and sugar households, respectively.

Because preschoolers start off so far below their recommended calorie intakes, even though distribution is relatively equitable at the margin, even high-income households would have to realize substantial increases in income for the calorie intakes of preschoolers to reach their recommended levels, given these low elasticity values. In the following chapter, we explore the issue of whether increases in calorie intakes of preschoolers actually improves their nutritional status.

9. DETERMINANTS OF HEIGHTS AND WEIGHTS OF PRESCHOOL CHILDREN

INTRODUCTION

In this final chapter on the intrahousehold effects of changes in the agricultural production system, we examine the effect of calorie intakes and a variety of nonfood variables on the heights and weights of preschool children. The determinants of preschooler calorie intakes were discussed in detail in the previous chapter. Some specific nonfood variables whose patterns will be looked at across expenditure quintiles and crop tenancy groups are time spent by the mother in childcare, morbidity, sanitary conditions, and infant feeding practices.

The chapter begins by presenting data on the heights and weights of our sample population, as measured by Z-scores. Next a descriptive analysis is undertaken of the data for the nonfood determinants of nutritional status which were just mentioned above. Finally, Z-scores are regressed on calorie intakes and these nonfood variables to determine their specific effects on nutritional status.

ANTHROPOMETRIC DATA FOR PRESCHOOL CHILDREN AND MOTHERS

Anthropometric data on height and weight were collected in each of the four rounds for all individuals present at the time of interview, although only the data for preschoolers and their mothers are presented

here. The standards against which heights and weights are compared are the United States National Center for Health Statistics references for a healthy United States population.

Z-scores are computed by subtracting an age- and sex-specific standard from the actual height or weight measurement and dividing the result by an age- and sex-specific standard deviation for the standard population. A negative Z-score indicates that heights and/or weights are below mean levels for the reference population. The Z-score for height-for-age (ZHA) is a measure of nutritional status over the long run. The Z-score for weight-for-length (ZWL) is a short-run measure of nutritional status. The Z-score for weight-for-age (ZWA) measures the result of a combination of short-run and long-run influences. The analysis here will focus on Z-scores for height-for-age and weight-for-length.

Table 9.1 presents all three Z-scores for preschool children disaggregated by expenditure quintile and by age. The ZHA scores for preschoolers less than one-year old indicate a very strong association between heights and income. Although data are not presented to substantiate such a conclusion, this pattern is probably in part a reflection of better maternal nutrition in high-income groups during pregnancy. As age increases and children are weaned, ZHA scores for all expenditure quintiles decline. However, they decline more rapidly for higher-income quintiles so that by the age of four, heights of higher-income children are only marginally better than heights of lower-income children. There appears to be little association between

Table 9.1--Height-for-age, weight-for-age, and weight-for-length by age and expenditure quintile for preschool children

Expenditure Quintile	HEIGHT-FOR-AGE (ZHA)					
	Age in Years					
	0	1	2	3	4	All
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

Expenditure Quintile	WEIGHT-FOR-AGE (ZWA)					
	Age in Years					
	0	1	2	3	4	All
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

Expenditure Quintile	WEIGHT-FOR-LENGTH (ZWL)					
	Age in Years					
	0	1	2	3	4	All
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

income and weight-for-length. ZWA scores show a pattern which is a mix of the patterns for the ZHA and ZWL scores.

ZHA scores disaggregated by crop tenancy group are given in Table 9.2. The sample in this table differs from the sample in Table 9.1 in that it includes only children where breastfeeding has been completely stopped. As discussed in Chapter 8, it is only for these children that we have a complete accounting of calorie intakes so that only these observations can be included in the regression analysis presented in Chapters 8 and 9. Children have been divided into age terciles to look at the phenomenon of declining ZHA scores by age, while maintaining a reasonable number of observations in each cell.

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 preshoolers in any of the remaining six groups. Observations for these high-income sugar household children, then, are consistent with the pattern seen in Table 9.1 of higher-income children getting a better start nutritionally than lower-income children. However, having started out significantly taller, sugar owner and owner/renter children are shorter on average than their corn household counterparts by the time they reach the oldest age tercile (although the difference in average heights between the two crop groups 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

Table 9.2--Height-for-age (ZHA) by crop tenancy group by age tercile for children for whom breastfeeding has been stopped

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

* Significantly different from all other crop-tenancy groups, except other group designated with a *, for the same age tercile, at 20 percent level, one-tailed t-test.

** Significant difference between first and third age tercile with crop-tenancy group, at 10 percent level, one-tailed t-test.

groups, a result that might have been expected *a priori* because of their low incomes.

Table 9.3 presents average heights and weights of mothers by expenditure quintile and by crop tenancy group. Mothers in high income groups tend to weigh more than mothers in low-income groups, which is consistent with the calorie intake data for mothers presented in Table 8.1, and consistent with the argument made above that higher-income women would tend to be better nourished during pregnancy than lower-income women. Mothers in households without access to land weigh less than mothers in households with access to land, which is consistent with the apparent greater competition for calories among parents and children, as estimated in Table 8.4. There are no noticeable differences in mother's heights across expenditure quintiles or crop tenancy groups.

TIME ALLOCATION PATTERNS OF MOTHERS

How each member of a rural household (adult or child, male or female) spends his/her time will depend, among other things, on the resources available to that household for generating income at home (especially land), the number of household members who have the skill (e.g., by virtue of experience), the strength (which comes with age), and the willingness (e.g., according to norms prescribed by the culture) to perform certain necessary tasks at home, and employment opportunities that are available in the labor force. To what extent are these intrahousehold time allocation decisions influenced by the switch from corn to sugar production, and how do these changes in time

Table 9.3--Mother's weight and height by expenditure quintile and by crop and tenure group

Expenditure Quintile	Mother's Weight (kilograms)	Mother's Height (centimeters)
1	45.9	150
2	45.2	150
3	46.5	151
4	46.9	150
5	50.6	151
All	47.0	150
Corn	46.4	150
Corn owner	46.9	150
Corn owner/tenant	47.7	150
Corn share tenant	46.7	151
Corn laborer	44.3	149
Sugar	47.7	151
Sugar owner	48.2	151
Sugar owner/renter	50.4	151
Sugar renter	48.2	152
Sugar laborer	45.5	150

allocation patterns affect nutrition? Because of a presumption that mothers are primarily responsible for the welfare of preschool children, we focus in this section on the mothers' time allocation patterns.

Table 9.4 gives the percentage distribution of mother's time divided into six broad categories of activities, disaggregated by expenditure quintile and crop tenancy group. These percentages are net of time spent on personal care (sleeping, eating, grooming), which took up an average of about 10.5 hours a day and did not vary much between groups. What is perhaps most remarkable about the percentages presented in Table 9.5, is that they vary so little across the various expenditure and crop tenancy groups. This reflects a certain commonality of tasks that must be performed in all rural households no matter how household income is earned, and the fact that income sources are so diverse (see Table 6.6) that our categorizations by crop and tenure status perhaps imply a greater amount of heterogeneity across households than actually exists.

Nevertheless, certain reasonable patterns do emerge. Subsistence activities are lowest for the corn and sugar laborer wives, whose households have the least access to land. Childcare and domestic activities tend to be lower for households with more access to land and with higher tenancy status. As was seen in Table 2.2, these households tend be older and larger, with several older children who can assist with these chores. Leisure time tends to be higher and subsistence activities lower for sugar household wives than for corn household wives. This is consistent with the reduced responsibilities of women

Table 9.4--Percentage allocation of mother's time, net of personal care time,[a] by expenditure quintile, and by crop tenancy group

Expenditure Quintile	Leisure[b]	Domestic Activities[c]	Subsistence Activities[d]	Child Care[e]	Labor Force Participation[f]	Marketing Activities[g]	Total
1	32.7	30.2	18.3	11.4	5.2	2.3	100.0
2	32.5	32.2	16.4	9.7	5.8	3.5	100.0
3	30.8	32.9	16.2	8.5	8.1	3.6	100.0
4	34.2	32.6	13.2	8.4	7.3	4.4	100.0
5	35.2	29.8	13.2	7.0	11.9	3.0	100.0
All	33.0	31.6	15.5	9.0	7.6	3.4	100.0
Crop-Tenancy Group							
Corn	32.3	32.3	16.9	9.1	6.0	3.4	100.0
Corn landowners	33.0	31.0	19.1	6.0	7.3	3.6	100.0
Corn mixed tenancy	30.4	32.4	19.9	8.7	4.8	3.8	100.0
Corn share tenancy	32.4	32.0	15.7	10.5	6.4	3.0	100.0
Corn laborers	33.2	33.9	14.3	9.6	5.4	3.6	100.0
Sugar	34.3	30.8	14.3	9.1	7.8	3.7	100.0
Sugar landowners	35.6	27.5	17.3	7.6	7.8	4.2	100.0
Sugar mixed tenancy	36.8	29.1	14.2	8.0	8.2	3.7	100.0
Sugar renter	28.9	33.7	17.2	10.3	6.7	3.3	100.0
Sugar laborers	35.3	32.3	10.6	10.1	8.2	3.6	100.0

[a] Personal care = eating, sleeping, grooming.
[b] Leisure = rest, visiting friends, church, and attending meetings.
[c] Domestic activities = cooking, cleaning, fetching water, firewood.
[d] Subsistence activities = feeding and attending livestock, cultivating own land, vegetable, and fruit cultivation.
[e] Childcare = breastfeeding, feeding children, bathing child.
[f] Labor force participation = nonagricultural employment, working in plot not cultivated by HH.
[g] Marketing activities = marketing for food, shopping for nonfoods.

Table 9.5--Minutes spent by mother in childcare and in fieldwork by currently breastfeeding mothers and by mothers who have stopped breastfeeding

Crop-Tenancy Group	Childcare				Fieldwork		Number of Cases	
	Currently Breastfeeding Mothers			Mothers Who Have Stopped Breastfeeding				
	Total Childcare Time	Breast-feeding	Other Child-care	Other Childcare	Currently Breastfeeding Mothers	Mothers Who Have Stopped Breastfeeding	Currently Breastfeeding Mothers	Mothers Who Have Stopped Breastfeeding
Corn	151	48	104**	44**	95*,**	114**	248	659
Corn owners	100	36*	64**	44**	102*	120	18	164
Corn mixed owners/ tenants	152*	43	108**	39**	100*	126*	48	125
Corn share tenants	163	51	112**	48**	84**	107**	114	242
Corn laborers	144	48	96**	40**	110	108	68	128
Sugar	157	49	107**	39**	64*,**	106**	164	429
Sugar owners	129	48*	81**	41**	43*,**	114**	29	122
Sugar mixed owners/ renters	198*	51	147**	30**	14*,**	95*,**	22	91
Sugar renters	193	54	139**	41**	88	116	32	67
Sugar laborers	141	47	94**	42**	77	100	81	129

* Significantly different at 10 percent level, one-tailed t-test, comparing like tenancy groups across crops.

** Significantly different at 10 percent level, one-tailed t-test, comparing like variables across breasfeeding and nonbreastfeeding mothers.

in sugar production discussed in Chapter 6. The one exception to this pattern are mothers in the sugar renter group, which was found in Chapter 6 to have invested an inordinate amount of family time in hand weeding for corn production, a task in which women are heavily involved.

Further disaggregation of the two-way table in Table 9.4 by currently breastfeeding mothers and mothers who have stopped breastfeeding, provides a more revealing picture of differences in mother's time allocation patterns between corn and sugar households. Table 9.5 presents data for this three-way disaggregation for minutes spent by mothers in childcare and in doing agricultural fieldwork (both own-farm and off-farm). Mothers who are breastfeeding spend about 110 more minutes a day in childcare than do nonbreastfeeding mothers, with less than half of this extra time being accounted for by breastfeeding itself. In Table 9.4, 110 minutes accounts for about 14 percent of the total time available to mothers (net of time for personal care).

Comparing like tenancy groups across crops (excluding the laborer groups), breastfeeding time and other childcare time is consistently higher for the sugar household mothers than for the corn household mothers for children who are being breastfed. Once breastfeeding is stopped, childcare time is consistently lower for sugar household mothers than for corn household mothers (again excluding the laborer groups).

This result could have been predicted *a priori*, 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 either corn or sugar households), the lower opportunity cost of women's time in sugar production will leave more time for childcare for sugar household mothers. Once breastfeeding is discontinued, however, sugar household mothers have less incentive to stay at home so that childcare time will be reduced. This line of reasoning holds only for households with access to land, so that the pattern breaks down when comparing the corn and sugar laborer groups.

Note how fieldwork time rises only marginally between breastfeeding mothers and mothers who have stopped breastfeeding for corn owner and owner/tenant households, in contrast with sugar owner and owner/renter mothers who spend much less time in fieldwork during breastfeeding than after. It can be presumed that fieldwork time of sugar owner and owner/renter mothers, whose children get an especially good nutritional start, is similarly low during pregnancy as well. Interestingly, once breastfeeding has been stopped, there is relatively little difference in fieldwork time for all eight crop tenancy groups, despite the wide differences in income levels and access to land.

While the patterns just described in Table 9.5 are consistent with theory, some of the differences between like tenancy groups are small and are for the most part statistically insignificant. Table 9.6 presents data for time away from the house, broken down by own-farm and off-farm activities, which is presumed to be negatively associated with the amount and quality of childcare time that the mother would be able to provide. Again, comparing like tenancy groups across crops but excluding the laborer households, total time away from the house (which

Table 9.6--Time spent by mothers away from the house by own-farm and off-farm activities by currently breastfeeding mothers and mothers who have stopped breastfeeding by crop tenancy group

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
Corn	86**	118*,**	+32	105**	150*,**	+45	191**	269*,**	+78
Corn Owner	108	130	+22	108	163	+55	215	292	+77
Corn Owner/Renter	108*	136	+28	96*,**	149*,**	+55	203**	285**	+82
Corn Share Tenant	91	107	+18	100*,**	150**	+50	191*,**	256**	+65
Corn Laborer	58**	109*,**	+51	118	136*	+ 8	176**	245**	+69
Sugar	69**	99*,**	+30	104**	196*,**	+92	172**	295*,**	+123
Sugar Owner	65**	118**	+53	102**	179**	+ 77	166**	297**	+131
Sugar Owner/Renter	16*,**	101**	+85	165*	207*	+ 42	181**	309**	+128
Sugar Renter	84	113	+29	50*,**	182**	+132	134*,**	295**	+161
Sugar Laborer	79	69*	-10	109**	213*,**	+104	187**	282**	+ 95

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

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

* Significantly different at 5 percent level, one-tailed t-test, comparing like tenancy groups across crops.

** Significantly different at 5 percent level, one-tailed t-test, comparing like variables across breastfeeding and nonbreastfeeding mothers.

increases for all eight crop tenancy groups once breastfeeding is stopped) is consistently lower for the sugar household mothers during breastfeeding, and consistently higher for sugar household mothers once breastfeeding has been stopped. 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.

The mothers' time allocation data, then, are consistent both with the better nutritional start that higher-income sugar household preschoolers get, and with the more rapid decline in their nutritional status after breastfeeding has been stopped. The magnitudes of the differences in time spent away from the house and in childcare time between corn and sugar households, while perhaps contributing factors, cannot fully account for the rapid decline in the ZHA scores for the sugar household children. Morbidity patterns, which will be discussed in the following section, offer a more complete explanation.

Before turning to morbidity, however, we comment here on the relationship between mothers' time allocation patterns and the behavioral differences that were found in Chapter 8 in the intrahousehold distribution of calories between corn and sugar households. Once breastfeeding is stopped, corn household mothers spend less time away from the house and more time with their preschoolers than do sugar household mothers. At the same time, corn household preschoolers are favored somewhat in the intrahousehold distribution of calories relative to their sugar household counterparts. The difference in this behavioral relationship between corn and sugar households was strong

enough to be found statistically significant. The dichotomy in mothers' time allocation patterns just discussed provides a plausible explanation for this statistically significant difference.

PRESCHOOLER MORBIDITY PATTERNS

Respondent 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 time of interview. Fever and diarrhea were the most frequently mentioned symptoms. The prevalence rates of all sickness, fever, and diarrhea are reported in Table 9.7, disaggregated by children who are currently breastfed and for whom breastfeeding has been stopped, by expenditure quintile, and by crop tenancy group. Average duration of each reported sickness, not shown, was about 4.5 days and did not vary much across expenditure or crop tenancy groups.

The higher prevalence rates for currently breastfed children are merely a reflection of the fact that younger children are sicker more often than older children. Surprisingly, morbidity appears to be positively related to income level, in particular for children for whom breastfeeding has been stopped. This result is due to the substantially higher prevalence rates for sugar households than for corn households. Note the expected inverse relationship between income and fever and diarrhea for the four corn tenure groups after breastfeeding has been stpped. For sugar household children, fever and diarrhea combined occur 25 percent more frequently than for corn household children.

Table 9.7--Prevalence of sickness, fever, and diarrhea by currently breastfeeding children and children who have stopped breastfeeding, by expenditure quintile and by crop-tenancy group

Expenditure Group	Currently Breastfed Children			Children for Whom Breastfeeding Has Been Stopped		
	Sickness	Fever	Diarrhea	Sickness	Fever	Diarrhea
1	0.31	0.21	0.03	0.24	0.17	0.03
2	0.29	0.21	0.04	0.27	0.19	0.04
3	0.34	0.16	0.07	0.29	0.14	0.05
4	0.39	0.28	0.02	0.30	0.20	0.03
5	0.41	0.21	0.07	0.32	0.21	0.03
All	0.33	0.21	0.05	0.28	0.18	0.04
Crop-Tenancy Group						
Corn	0.32	0.22	0.05	0.27	0.17	0.03
Corn owners	0.22	0.11	0.03	0.24	0.15	0.01
Corn owners/tenants	0.38	0.32	0.05	0.28	0.16	0.03
Corn share tenants	0.33	0.21	0.05	0.29	0.18	0.04
Corn laborers	0.31	0.21	0.04	0.26	0.19	0.04
Sugar	0.36	0.22	0.05	0.30	0.20	0.05
Sugar owners	0.32	0.21	0.03	0.28	0.20	0.02
Sugar owners/renters	0.43	0.17	0.04	0.32	0.20	0.06
Sugar renters	0.34	0.28	0.03	0.32	0.21	0.03
Sugar laborers	0.37	0.22	0.07	0.30	0.20	0.07

Regressions below will show fever and diarrhea to be significantly and negatively related to weight-for-length, a short-run measure of nutritional status. Again, the pattern of sickness across the crop groups is quite consistent with the more rapidly declining ZHA scores for sugar household children. Sugar household mothers spend less time in childcare and more time away from the house, despite the fact that their preschoolers are sick more often.

HOUSEHOLD SANITATION CHARACTERISTICS AND INFANT FEEDING PRACTICES

What are possible explanations for the higher morbidity rates in sugar households? Table 9.8 presents data relating to quality of sanitation facilities by expenditure quintile and crop tenancy group. An increase in income is associated with improved primary water sources, water sources which 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. However, for none of these variables are poorer facilities consistently associated with sugar households, nor do the improved facilities for higher-income households seem to have resulted in lower morbidity for the preschoolers in these households.

Infant feeding practices can be very important determinants of preschooler morbidity patterns. Table 9.9 presents data on various aspects of feeding practices by crop tenancy group and expenditure quintile. The practice of bottlefeeding is positively associated with

Table 9.8--Sanitation characteristics by expenditure quintile and by crop-tenancy group

	Percent of HH With Improved Primary Watersource (Piped, Deepwell, Cement Tank)	Percent of HH with Distance to Primary H_2O < 50m	Percent of HH With Improved Toilets	Type of Floor Material (1 = dirt; 4 = concrete)	Type of Roof Material (1 = nipa; 3 = sheet metal)	Percent of Houses Where Electricity is Available
Expenditure Quintile						
1	17	33	31	2.51	2.30	14
2	15	29	34	2.59	2.22	20
3	18	39	48	2.42	2.26	21
4	18	37	53	2.69	2.63	33
5	35	58	61	3.03	2.86	58
All Groups	20	39	45	2.65	2.45	29
Crop Tenancy Group						
Corn	15	36	41	2.57	2.34	25
Corn owners	13	43	57	2.83	2.80	33
Corn mixed tenancy	11	43	50	2.74	2.54	43
Corn share tenancy	15	34	36	2.52	2.28	24
Corn laborers	18	27	29	2.28	1.36	4
Sugar	31	43	50	2.78	2.59	33
Sugar owners	24	46	56	3.18	3.00	63
Sugar mixed tenancy	37	53	53	2.88	2.90	50
Sugar renters	26	32	81	2.74	2.64	29
Sugar laborers	35	41	26	2.43	2.07	4

Table 9.9--Infant feeding practices by expenditure quintile and by crop and tenure group

Expenditure Group	Breastfeeding			Bottlefeeding		Age When Weaning Foods First Introduced	Percent That Boil Water for Children
	Percent Ever Breastfed	Age When Breastfeeding Stopped	Percent Where Breastfeeding Stopped Gradually	Percent Ever Bottlefed	Age When Bottlefeeding Stopped		
1	95	13.8	39	31	5.4	5.3	6
2	100	14.0	36	31	6.0	5.4	8
3	94	16.3	41	38	6.0	5.1	13
4	93	12.1	50	55	5.8	4.9	19
5	84	14.2	40	69	5.9	5.4	22
All	94	14.1	41	43	5.8	5.2	13
Crop-Tenancy Group							
Corn	94	13.8	36	38	5.3	5.1	12
Corn owner	80	13.9	33	39	4.4	4.7	18
Corn owner/tenant	100	13.4	37	45	4.4	4.3	20
Corn tenant	95	13.7	36	43	5.5	5.2	10
Corn laborer	97	14.1	38	25	7.1	5.8	5
Sugar	92	14.5	49	50	6.5	5.5	14
Sugar owner	86	14.1	43	50	7.7	5.1	4
Sugar owner/renter	84	16.2	44	69	5.7	5.9	7
Sugar renter	98	13.0	62	57	7.4	5.5	29
Sugar laborer	95	15.0	47	37	5.6	5.5	13

rising incomes. Sugar households bottlefeed more of their children than their corn counterparts. Laborer households bottlefeed the least, reflecting their lower purchasing power. Sugar household mothers delay the introduction of weaning foods for longer than corn household mothers, stopping both breastfeeding and bottlefeeding at older ages.

These tendencies for sugar household mothers to delay the introduction of weaning foods and to delay stopping of breastfeeding and bottlefeeding relative to their corn household counterparts, are indicative of the greater time availability of sugar household mothers for childcare during the first 18 months or so after an infant's birth, as discussed in the previous section. While many 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.

NUTRITIONAL KNOWLEDGE OF MOTHERS

In each survey round, mothers were given a quiz of ten or so 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 this area affected the intrahousehold distribution of resources, especially as compared with the effect of the years of formal education.

Out of 40 questions, 17 were selected for their ability to split the correct and incorrect answers into two fairly even groups. A nutritional 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 7.48 and are highly correlated with mother's education.

Z-SCORE ESTIMATIONS

In estimating the determinants of nutritional status, two sets of estimates were run, one with height-for-age as the dependent variable and a second with weight-for-length as the dependent variable. Exogeneity between preschooler calorie intakes and both these dependent variables was tested for and could not be rejected. Table 9.10 presents the regression estimations where ZWL is the dependent variable and Table 9.11 the regression estimations where ZHA is the dependent variable. Both sets of regressions were run for the whole sample and for subsets of corn and sugar households. The total sample size for these regressions was 1,452, down from the 1,689 observations used in the preschooler calorie intake regressions primarily because of missing values for a birth spacing variable (discussed below) for first-born children.

In the ZWL regressions, preschooler calorie intakes were found to be a positive and significant determinant of weight-for-length for the whole sample, and for the corn 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 0.36, 0.40, and 0.36 for the whole sample, corn household subsample, and sugar household subsample, respectively.

Table 9.10--Regression results where the dependent variable is weight-for-length (ZWL)

	All Households		Corn Households		Sugar Households	
(Constant)	-2.22445	(-3.13)	-1.28324	(-1.32)	-3.44583	(-2.60)
PCALAEQ	1.10x10-04	(4.98)*	1.13x10-04	(4.03)*	1.09x10-04	(2.55)*
DIARR	-0.43587	(-3.98)*	-0.34395	(-2.30)*	-0.46501	(-2.79)*
FEVER	-0.29396	(-5.30)*	-0.12020	(-1.58)	-0.41950	(-4.61)*
MNTHBFED	6.50x10-04	(0.24)	-8.38x10-03	(-2.26)*	0.01003	(2.27)*
BRTHSP1	-2.58x10-03	(-2.45)*	-1.14x10-03	(-0.90)	-4.28x10-03	(-1.91)
FATHED	1.95x10-03	(0.26)	-0.01325	(-1.25)	0.02210	(1.72)
AGEMOM	1.27x10-03	(4.16)*	6.02x10-04	(1.51)	2.24x10-03	(4.12)*
CHILDCRE	-5.47x10-04	(-2.79)*	-6.85x10-04	(-2.75)*	-7.21x10-04	(-2.13)*
NUTRSC1	-5.06x10-03	(-0.76)	-0.01193	(-1.44)	2.42x10-03	(0.20)
AVNETWTH	-2.27x10-07	(-0.39)	1.09x10-06	(0.82)	-7.59x10-07	(-1.10)
SEX	-0.15110	(-3.57)*	-0.08045	(-1.46)	-0.30135	(-4.11)*
HTFATH	-3.53x10-03	(-1.03)	-5.56x10-03	(-1.11)	-1.67x10-03	(-0.30)
HTMOTH	0.01277	(4.01)*	0.01089	(3.14)*	0.01548	(1.99)*
RD1	-0.09981	(-1.67)	-0.03844	(-0.50)	-0.13024	(-1.25)
RD2	-0.12665	(-2.09)*	-0.12666	(-1.62)	-0.08331	(-0.80)
RD3	-0.04085	(-0.65)	-0.02505	(-0.31)	0.03147	(0.30)
	R-Square =	.097	R-Square =	.077	R-Square =	.176
	F =	9.64	F =	4.06	F =	6.78
	N =	1452	N =	800	N =	526

Note: T-statistics in parentheses.

* Significant at 5 percent level.

Variable Labels:

PCALAEQ = preschooler calorie intake per adult equivalent per day
DIARR = zero-one dummy for diarrhea being reported in past two weeks
FEVER = zero-one dummy for fever being reported in past two weeks
MNTHBFED = months that child was breastfed before stopping
BRTHSP1 = months between births of present and previous child
FATHED = years of formal education of the father
AGEMOM = age of the mother in months
CHILDCRE = minutes spent in childcare in previous 24 hours
NUTSCR1 = measure of the nutritional knowledge of the mother
AVNETWTH = net worth of household assets
SEX = 0=female, 1=male
HTFATH = height of the father in centimeters
HTMOTH = height of the mother in centimeters
RD1,RD2,RD3 = zero-one dummy variables for survey round

Table 9.11--Regression results where the dependent variable is height-for-age (ZHA)

	All Households		Corn Households		Sugar Households	
(Constant)	-16.63214	(-16.9)	-16.09532	(-11.3)	-19.32006	(-11.2)
PCALAEQ	1.19x10-04	(3.89)*	9.97x10-05	(2.43)*	4.55x10-05	(0.82)
DIARR	0.07747	(0.51)	-0.19718	(-0.90)	0.38043	(1.76)
FEVER	0.12681	(1.65)	0.01008	(0.09)	0.34882	(2.96)*
MNTHBFED	0.01793	(4.76)*	0.03188	(5.88)*	7.74x10-03	(1.35)
BRTHSP1	7.42x10-03	(5.09)*	5.19x10-03	(2.76)*	0.01538	(5.29)*
FATHED	0.06266	(6.09)*	0.03494	(2.25)*	0.08104	(4.88)*
AGEMOM	1.01x10-03	(2.39)*	9.64x10-04	(1.65)	6.11x10-04	(0.87)
CHILDCRE	3.36x10-04	(1.24)	2.52x10-04	(0.69)	5.34x10-04	(1.22)
NUTRSC1	-0.01285	(-1.39)	-0.01181	(-0.98)	-0.02026	(-1.27)
AVNETWTH	6.48x10-07	(0.81)	2.45x10-06	(1.26)	8.30x10-07	(0.93)
SEX	-0.05023	(-0.86)	-0.09564	(-1.19)	0.05613	(0.59)
HTFATH	0.05553	(11.69)*	0.06289	(8.55)*	0.04589	(6.34)*
HTMOTH	0.02676	(6.07)*	0.01644	(3.23)*	0.05436	(5.40)*
RD1	2.32x10-03	(0.03)	-0.11215	(-1.00)	0.17218	(1.28)
RD2	0.08333	(0.99)	-0.02411	(-0.21)	0.17915	(1.33)
RD3	0.02038	(0.23)	0.01858	(0.16)	-0.02863	(-0.20)
	R-Square = .190		R-Square = .162		R-Square = .298	
	F = 21.05		F = 9.48		F = 13.48	
	N = 1452		N = 800		N = 526	

Note: T-statistics in parentheses.
* Significant at 5 percent level.

Variable Labels:

PCALAEQ = preschooler calorie intake per adult equivalent per day
DIARR = zero-one dummy for diarrhea being reported in past two weeks
FEVER = zero-one dummy for fever being reported in past two weeks
MNTHBFED = months that child was breastfed before stopping
BRTHSP1 = months between births of present and previous child
FATHED = years of formal education of the father
AGEMOM = age of the mother in months
CHILDCRE = minutes spent in childcare in previous 24 hours
NUTSCR1 = measure of the nutritional knowledge of the mother
AVNETWTH = net worth of household assets
SEX = 0=female, 1=male
HTFATH = height of the father in centimeters
HTMOTH = height of the mother in centimeters
RD1,RD2,RD3 = zero-one dummy variables for survey round

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 signficantly associated with short-run nutritional status. Coefficients are higher for the sugar household subsample where each incident of diarrhea or fever reduces the ZWL score by about -0.45, which is close to the sample average. 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 ZHA scores for sugar household children.

As will be seen below, total number of months that the preschooler was breastfed and number of months between the birth of the next older sibling and the preschooler (birth spacing) are important determinants of heights. The negative association seen between birth spacing and weight-for-length is a reflection of the greater difficulty of taller children to meet their weight-for-length standards.

Several variables measuring education, experience, and nutritional knowledge were included in the estimations. Years of education of the mother is not included in the Z-score regressions shown in Tables 9.10 and 9.11 because of the high correlation with the nutritional knowledge variable. These and other regressions that were run indicate that neither of the two variables is significant, whether ZWL or ZHA is the dependent variable for any of the subsamples. In the ZWL regressions, years of education of the father is not significant. The age of the

mother, a proxy for her experience in child rearing, is significant for the whole sample and for the sugar household subsample as well.

Although the effect is small, time spent in childcare is negatively and significantly associated with short-run nutritional status, the opposite sign than had been expected. This is probably due to the greater amount of time that is spent in childcare when the preschooler is sick. A dummy variable for sex indicates that male preschoolers are further below their standard weight-for-lengths than female preschoolers. Average net worth is not significant for any of the samples. The mother's height is positively and significantly associated with her child's ZWL score, while the father's height is not.

Turning now to the ZHA regression results, preschooler calorie intakes during the past 24-hours are a good enough proxy for their calorie intakes over the long run, that there is still a positive and significant association between calorie intakes and height-for-age for the whole sample and the corn household subsample. While the absolute magnitudes of the coefficients on preschooler calorie intakes are very similar in Tables 9.10 and 9.11, because the ZHA scores are so much higher in absolute value than the ZWL scores, the estimated ZHA elasticities with respect to calorie intakes are much lower, specifically 0.10, 0.09, and 0.04 for the whole sample, corn household subsample, and sugar household subsample, respectively.

Occurrences of diarrhea and fever in the last two weeks have no significant association with long-run nutritional status for the whole sample. The longer that a child is breastfed and the longer the period of time between births, the taller the children will be, as indicated

by the positive and significant coefficients on the months breastfed and birth spacing variables.

Years of education of the father is positively and significantly related to ZHA for all three regression samples. The age of the mother is significant for the whole sample. Average net worth is again insignificant. The dummy variable for sex is not significant for height-for-age, as it was for weight-for-length. Both mother's and father's heights are positively and significantly related to their child's height. This last result raises the prospect that *ceteris paribus* better nourished children in this generation will result in taller children in the following generation.

F-statisics were computed to test the equality of the coefficients between the corn and sugar household subsamples for both dependent variables. In both cases the null hypothesis of equality was rejected. This result was more or less expected, given the different morbidity rates between the groups and the more rapidly declining ZHA scores for sugar household children.

To look more closely at the issue of the more rapidly declining ZHA scores for the sugar household children, the samples for the ZHA regressions reported in Table 9.11 were disaggregated into age terciles and rerun. The results for selected variables (which were all significant in Table 9.11) are reported in Table 9.12. For the whole sample, a monotonically declining pattern of coefficients and T-statistics is seen for the months breastfed and birth spacing variables. As children get older, the influence of these variables declines. The same type

Table 9.12--Summary of selected coefficients for ZHA regressions disaggregated by age tercile and by crop group

Age Tercile	MNTHBFED	BRTSP1	FATHED	AGEMOM	PCALAEQ
			All Households		
1	0.02838 (3.8)	0.01002 (4.2)	0.08140 (4.7)	0.00135 (1.7)	1.52 (3.0)
2	0.01980 (3.0)	0.00654 (2.2)	0.03846 (2.1)	0.00154 (2.0)	1.05 (2.0)
3	0.01114 (1.9)	0.00424 (1.7)	0.04307 (2.4)	0.00096 (1.4)	1.23 (2.2)
All	0.01793 (4.8)	0.00742 (5.1)	0.06266 (6.1)	0.00101 (2.4)	1.19 (3.9)
			Corn Households		
1	0.03547 (3.4)	0.01170 (3.6)	0.02218 (0.8)	-0.00013 (-0.1)	1.09 (1.5)
2	0.03078 (3.1)	0.00300 (0.8)	0.02773 (1.0)	0.00214 (2.1)	1.05 (1.5)
3	0.02683 (3.2)	0.00014 (0.0)	0.03177 (1.1)	0.00165 (1.8)	1.64 (2.1)
All	0.03188 (5.9)	0.00519 (2.8)	0.03494 (2.2)	0.00096 (1.6)	1.00 (2.4)
			Sugar Households		
1	0.03560 (2.9)	0.01322 (2.8)	0.12965 (4.5)	0.00156 (1.3)	1.20 (1.2)
2	0.00298 (0.3)	0.02147 (3.5)	0.01733 (0.6)	0.00173 (1.4)	0.57 (0.6)
3	0.00633 (0.7)	0.01611 (3.2)	0.04547 (1.7)	-0.00069 (-0.6)	0.51 (0.6)
All	0.00774 (1.4)	0.01538 (5.3)	0.08104 (4.9)	0.00061 (0.9)	0.45 (0.8)

Note: T-statistics in parentheses.

of pattern is indicated for the remaining three variables, although the relationship is not perfectly monotonic.

However, a much different pattern emerges when the sample is subdivided further into corn and sugar household subsamples. For the sugar household children, note the tendency for the effects of the five variables to be felt most strongly in the first and second age terciles. This is consistent with the good nutritional start that sugar household children get, which has been mentioned so often in this chapter. The one exception is birth spacing, which is significant for all three age terciles. If mothers in sugar households are facing a serious time constraint with chores at home because of the greater time that they spend away from the house, then close birth spacings will tend to exacerbate the problem.

For the corn household subsample, on the other hand, the effects of the five variables tend to be most strongly felt in the second and third age terciles. Corn household children do not get as good a nutritional start, but they are able to maintain relatively constant ZHA scores as they grow older. Number of months breastfed is a much more significant variable for corn household children than for sugar household children. As noted above in Table 9.8, corn household mothers tend to terminate breastfeeding more quickly than sugar household mothers, possibly because of the difficulty of participating in corn production even while they are still breastfeeding (see fieldwork time in Table 9.6). It appears that the beneficial effects of prolonged breastfeeding stay with the corn household children even as they grow older. By contrast, the effect of birth spacing all but

disappears for the second and third age terciles, for households where the time that the mother spends at home is not as much of a constraint.

CONCLUSION

Having completed the analysis now of all four links between income and nutritional status as outlined in Chapter 2, it is possible to estimate the effect of changes in income on short-run nutritional status of preschoolers via the higher calorie intakes that higher incomes make possible. Using round numbers, the short-run income elasticity with respect to weight-for-length for the whole sample may be estimated by multiplying the individual elasticities for each link: (0.4)(0.2)(1.2)(0.4) = 0.04, implying that a doubling of income improves weight-for-length by only four percent.

This four percent difference for every 100 percent increase in income does not show up clearly across expenditure quintiles in Table 9.1 (see ZWL 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.

What effect does nutritional status in the short run have on long-run nutritional status? For the sample as a whole, a rough estimate of the long-run income elasticity with respect to height-for-age may be obtained, using the same methodology as followed in Appendix 1, by

dividing percentage increases in ZHA scores across expenditure quintiles (four-year olds in Table 9.1) by percentage increases in total expenditures across the same expenditure quintiles (Table 7.1). This gives a long-run elasticity estimate of about ten percent, which from Table 9.1 appears to be significant.

Note in Table 9.1 that the ZHA values in the lowest and highest expenditure quintiles remain almost unchanged for children from one year old to four years old. This implies that most of the improvement in height-for-age which is derived from income is realized before the preschooler's first birthday, mostly likely in the form of higher birth weights, although better nourishment during breastfeeding may play a part. Weaning takes an especially high toll on the heights of higher income preschoolers. After that, as preschoolers grow older, the relationship between income and height-for-age remains almost unchanged, which is consistent with the virtually zero correlation between income and short-run nutritional status noted above for the whole sample of households.

Matching up changes in ZHA scores across age groups and their corresponding ZWL scores for various expenditure quintiles and crop-tenancy groups (not shown), it appears that the ZHA scores of taller children are particularly vulnerable to negative ZWL scores, more so than the ZHA scores of shorter children who may have even worse ZWL scores. This is consistent with the observation that preschoolers in corn households tend to grow faster after breastfeeding has stopped than preschoolers in sugar households. In sugar households, the taller children who got the good nutritional start at birth are particularly

vulnerable to high morbidity rates which do not decrease with income By contrast in corn households, where morbidity rates do fall somewh with income (see Table 9.7), the negative effects of sickness tend t be concentrated on the shorter preschoolers where they will do the least harm in terms of reducing heights.

10. CONCLUSIONS AND POLICY RECOMMENDATIONS

As stated in Chapter 2, this research has had the twofold objectives of examining the process of commercialization in order to draw generalizable conclusions as to the key factors that generate favorable or unfavorable nutritional outcomes, and of 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 even to the study area itself, while others are more widely applicable, both in terms of methodologies that were tried and which could possibly be replicated in other studies of nutrition policies, and in terms of identifying those key factors just mentioned that may manifest themselves in similar ways in the other IFPRI commercialization studies.

The conclusions are organized initially by chapter heading, starting with the analysis of the corn production system. Next, some of the particular methodological approaches that were tried, both in terms of data collection and analysis, are evaluated. This is followed by a discussion of the implications of the research findings for nutrition policy in rural areas in the Philippines, for land tenure patterns in Mindanao, and for a strategy for developing Mindanao's vast agricultural potential.

THE CORN PRODUCTION SYSTEM

Corn is one of four major crops produced in the Philippines, providing employment for a high percentage of the rural population, especially south of Luzon. Nationwide, about 3.5 million hectares of corn are harvested each year, about the same area as rice, with Mindanao accounting for about two-thirds of this national total. Corn is the second most widely consumed staple after rice and the most widely consumed staple of low-income groups in the southern Philippines. Despite its being an inferior staple, its price has risen relative to the price of rice over the past two decades, in large part because of the increased demand for corn as an input to commercial livestock production.

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 improving soil fertility and to investing in extension programs for disseminating 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 as high input

levels have been more widely adopted. Fertilizer is being used at levels well below those that would maximize profits.

Carabao ownership is an important factor in the intensity with which inputs are used in corn production. Since yields are somewhat responsive to these inputs, carabao ownership would appear to be an important determinant of family well-being. The corn marketing system operates efficiently in Bukidnon. Producers on average save about 25 percent of the market price by storing and consuming their own corn produce.

THE SUGAR PRODUCTION SYSTEM

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 this study in part because it is being compared with corn, whose productivity is so abysmal for smallholders in our study area. Average returns of ₱4,500 per hectare per year (U.S.$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.

Several residents of Bukidnon have mentioned the possibility that sugar yields may decline in the future just as corn yields have in the

past. They argue that sugarcane roots go much deeper than corn roots so that soil nutrients are being used now, which had not been tapped before with corn. Most smallholders in our sample had only been growing sugar for two or three years, and average fertilizer applications on a per hectare per year basis are at about the same low level as for corn. Higher productivity of lands in Bukidnon, then, may explain why our sample of sugar farmers on average have done better than the general perception of the profitability of sugar production in Negros. One can only hope that the decline in yields between the 1983/84 and 1984/85 milling seasons is only marginally related to declining soil fertility.

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.

Related to this diversification issue, about 30 percent of respondent household incomes came from nonagricultural sources. It can also be presumed that these nonagricultural sources of employment are important in Negros, and that they declined significantly with the decline of sugar profits. These negative multiplier effects are felt much less strongly in Bukidnon, where other export crop prices such as

coffee, rubber, and cacao remained stable or were rising at the same time as sugar prices fell (CRC 1987).

COMPARISON OF CORN AND SUGAR PRODUCTION

Total labor inputs on a per hectare per year basis for our sample households are about the same for corn and sugar. The implication is that demand for labor remained about the same after the switch to sugar, as before its introduction. This conclusion requires one important qualification. Our household surveys covered smallholder producers, while most sugar production in Bukidnon takes place on large haciendas. To the extent that these haciendas have mechanized their production relative to smallholder producers (one hacienda used mechanical harvesters and several haciendas used mechanical planters, technologies borrowed from sugar production in Australia), demand for labor has been reduced.

Two-thirds of total labor inputs for corn production are provided by the households themselves and two-thirds of labor inputs for sugar production are provided by hired labor, a switch of 33 percent from family to hired labor when converting from corn to sugar. The increase in hired labor is due to a constraint of available household labor at harvest time and the greater use of hired labor for weeding the more profitable sugar crop. The decrease in family labor inputs is due to increased mechanization (plowing by tractor and in processing) and to more intensive family cultivation of corn plots by the sugar renter group, in comparison with corn household cultivation norms. This switch from hired to family labor has an important effect on demand for

women's and children's time in agricultural production, which falls quite dramatically for sugar.

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 to bear the risk of converting entirely to cash crop production, if for some reason the harvest failed or they were not able to market their crop. Because these unfavorable outcomes did not in fact materialize, they were left with large surpluses of corn which could then be marketed.

INCOMES, EXPENDITURES, AND CALORIE INTAKES AT THE HOUSEHOLD LEVEL

Total expenditure levels for sugar households for owner, owner/ renter, and renter groups are all higher than their corn household counterparts. This is consistent with the greater profits possible with sugar, but is also due in part to the larger areas cultivated by sugar households. Total expenditure levels are higher for corn owner than corn owner/tenant households, and higher for corn owner/ tenant households than for corn tenant households because of the shares of harvest (rents) that tenants pay landlords. Lowest incomes occur for households without access to land. There is no apparent difference between these two landless groups in terms of income or a variety of other welfare measures, whether wage income comes primarily from corn production or sugar production. Expenditures for each subgroup of a 14 group disaggregation of nonfood items, all rise consistently with income.

For all the sample households taken together, food budget shares decline from 79 percent for the lowest expenditure quintile to 57 percent for the highest expenditure quintile. At middle income levels, the estimated marginal propensity to spend an extra peso of income on food is 25 centavos. This translates into an income elasticity of about 0.4 for food expenditures.

The higher food expenditures of high income households went for the purchase of higher priced calorie sources, mostly meat. For each peso spent on food, a household from the lowest expenditure quintile increased its calorie availability by 520 calories, while a household from the highest expenditure quintile increased its calorie availability by only 320 calories, an increase of about 60 percent in the per calorie cost. At middle income levels, the elasticity of household calorie intake with respect to food expenditures was about 0.2, meaning that a doubling of household income results in less than a ten percent increase in household calorie intake per adult equivalent.

For all sugar tenure groups, the percent of calories purchased in the market was substantially higher than for the corresponding corn group, which had higher percentages of home-produced calories. This difference was due primarily to purchases of rice in the market by sugar households, while corn households ate more home-produced corn. Rice and corn demand estimations confirmed differences in demand behavior (after controlling for income) between sugar and corn households.

INTRAHOUSEHOLD DISTRIBUTION OF CALORIES

The average calorie adequacy ratio for preschool children is 0.75, while for adults the figure is 1.08. Calorie distribution within the household is skewed in favor of adults. This skewness may be necessary because of high activity levels of adults performing agricultural labor, higher than those assumed for a moderately active adult in the standard tables. It appears that for the lowest income households, households without access to land, there is serious competition for scarce household calories between adults and preschoolers.

The estimated elasticity of preschooler calorie intake with respect to household calorie intake is about 1.2, evaluated at the mean of the data. This means that preschooler calorie intakes increase by about 10 percent as income doubles. However, because calorie distribution is so skewed in favor of adults, income would have to double several times before preschoolers reach their recommended daily intakes of calories.

DETERMINANTS OF WEIGHTS AND HEIGHTS OF PRESCHOOLERS

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 children four years of age, which means that height-for-age deteriorates much faster for higher income children than lower-income children as they grow older.

Once breastfeeding has been stopped, preschool children from sugar owner and owner/renter households in the youngest age tercile are significantly taller than their counterparts in any of the remaining six crop tenancy groups. However, by the time these children reach the oldest age tercile, there is no statistically significant difference in the heights of children from the six crop tenancy groups with access to land. Preschool children in the oldest age tercile 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 that spend more than three-fourths of their income on food.

During breastfeeding, sugar household wives spend more time in childcare, less time doing fieldwork, and less time away from home than corn household wives (comparing only households with access to land). Once breastfeeding is terminated, sugar household wives spend more time away from the house, less time in childcare, and about the same amount of time in fieldwork as corn household wives. Such a dichotomy in time allocation patterns is consistent with the reduced responsibilities of sugar household wives in farm production and with the more rapid deterioration in height-for-age for sugar household children once breastfeeding is stopped.

Regressions show morbidity to be an important determinant of short-run nutritional status, weight-for-length. There appears to be little association between income and morbidity, although sugar household children are sick more often than corn household children,

which is also consistent with the more rapid deterioration in height-for-age for sugar household children as they grow older.

Regressions show preschooler calorie intakes to be positively and significantly related to short-run nutritional status, indicating that preschoolers who consistently eat more calories grow taller and weigh more. The short-run elasticity of preschooler calorie intake with respect to weight-for-length is 0.4. As incomes double, short-run nutritional status improves by only 4 percent, via the path of increased food consumption which higher incomes make possible.

METHODOLOGICAL CONSIDERATIONS

The Broad Range of Data Which Were Collected

At the outset of the data collection effort for all of the IFPRI commercialization studies, we started with the twin premises (a) that to study nutrition effects we had to look inside the household to understand *how* resources were allocated among individual household members and (b) that to understand *why* resources were allocated among individuals in the way that they were, we would have to understand the available agricultural production technologies, as well as have knowledge of other income-earning possibilities. After investing so many resources in collecting and analyzing a wide range of production, consumption, and nutrition data, was it worth the effort? Could we have achieved our objective of identifying the key factors that drive nutritional outcomes in the process of agricultural commercialization, for example, by collecting only detailed household expenditure informa-

tion, anthropometric data, and a few carefully selected variables related to health and nutrition?

For the Philippine study, in hindsight perhaps the most crucial component of the questionnaire turned out to be the 24-hour recall of individual food intakes, which was also the most difficult and expensive component of the survey to conduct, code, and prepare for analysis. First, as discussed in Appendix 1, these data provided a check against the estimate of household calorie availability from the food expenditure survey, and revealed that our estimates of food expenditures for high-income sugar owner and owner/renter households were apparently too high. This prevented a serious overestimation of the relationship between income and household calorie intake.

Second, even if food expenditures had been measured accurately, the individual intake data reveal that preschoolers even in high-income groups are still consuming well below their recommended daily intakes, even though average calorie requirements are being met at the household level. Because of the high correlation between increases in preschooler calorie intakes and household calorie intakes (see Table 8.3), substitution of household calorie intakes for preschooler intakes in the regressions in Chapter 9 would probably have generated positive and significant coefficients. However, assuming an equitable distribution of calories among all household members, it would have appeared (incorrectly) that raising income is a sufficient condition for closing the calorie gap for preschoolers.

What insights do the detailed production and income data provide? First, in the context of a declining sugar industry in the Philippines,

they revealed, somewhat unexpectedly, that sugar profits were higher than corn profits. If the opposite assumption had been made (if production data had not been collected), the higher expenditures for sugar households would have to have been attributed either to larger landholdings, or nonagricultural sources of income, or both, making it impossible to sort out the particular impact of sugar income on nutrition. In any event, especially because of the very diverse sources of income for households of both crop types, in terms of the experimental design it is obviously crucial to confirm that high percentages of income are derived from corn production by the corn households and from sugar production by the sugar households.

Second, one of the major effects of the introduction of sugar was a serious deterioration in land tenure patterns. A detailed knowledge of the corn and sugar production systems provides a plausible economic explanation for why this result might occur, and points to possible remedies for avoiding this unwelcome effect of export cropping. This second point is discussed in more detail later in this chapter.

Third, knowledge of the decreased role of women in farm production with the adoption of sugar, explains differing time allocation patterns between mothers in sugar and corn households, which are consistent with the differing patterns in the nutritional status of their preschoolers across age groups. Furthermore, this difference in time allocation patterns provides a plausible explanation for a difference in intra-household distribution of calories for corn and sugar households.

The conclusion is that collection of the detailed production data, and data for individual calorie intakes and time allocation patterns,

lead to a much richer, more complete understanding of how the switch to sugar affected nutrition. Much more specific policy recommendations are now possible, in terms of focusing on the skewed distribution of calories within the household alongside the propensity to purchase expensive sources of calories, in terms of being aware that women's activity patterns during pregnancy, breastfeeding, and after breastfeeding has been stopped are very much related to the nutritional status of their children, in terms of pinpointing constraints to increased corn and sugar production and profits, and in terms of realizing that policy solutions in all three areas appear to be interdependent.

Frequency/Accuracy of Calorie Intake and Time Allocation Recall Data

Because of the wide day-to-day variation in individual calorie intakes, at the outset of data collection there was a great deal of uncertainty, first whether four 24-hour recall surveys for a sample of approximately 500 households would constitute a sufficiently large sample that the presumed correlation between daily calorie intakes and average intakes over some longer period of time would generate reasonable estimates of the relationship between individual calorie intakes and nutritional status. Second, the obvious inability of mothers to know or to remember with total accuracy what each individual in the household has eaten in the previous 24 hours only added to the uncertainty. Because of the prohibitive cost of weighing actual intakes and the fear that this would alter food intake behavior, this alternative technique was not used.

Three aspects of the analysis of the survey data tend to confirm that the sample was sufficiently large and individual calorie intake measurements sufficiently accurate, that the data collection effort was worthwhile. First, as discussed in Appendix 1, for six of eight crop tenancy groups, measurements of calorie availability and calorie intakes at the household level were within three percent of each other. Given the pattern of incomes and food expenditures across the various crop tenancy groups discussed in Chapter 7, this ensured a positive and significant relationship between household calorie intakes and income, which would have been expected *a priori*. Second, in accordance with *a priori* expectations, regression estimates in Chapter 8 (Table 8.4) indicate greater competition for scarce household calories in low-income households. Third, again in accordance with *a priori* expectations, regression estimates in Chapter 8 (Table 8.3) and Chapter 9 (Tables 9.10, 9.11, and 9.12) show individual calorie intakes to be negatively associated with sickness and positively associated with nutritional status, more so with short-run nutritional status than long-run nutritional status, and more so with younger preschoolers than older preschoolers.

There were similar concerns with respect to collection of the 24-hour recall of women's time allocation patterns. Given day-to-day variation in activity patterns, what would be an appropriate sample size, and how could these data be collected accurately? Again, it was decided that assigning an enumerator to watch and record all activities might alter behavior, and in any event would be too expensive, so that a recall of activities was used.

Pretesting of a methodology which asked respondents to estimate how many minutes had been spent on each of several activities in the previous 24 hours failed miserably. What worked much better was a methodology that asked respondents to identify the times at which they had awakened, eaten breakfast, lunch, and dinner, and gone to bed, and then without prompting allowed the respondent to name the sequence of activities that she had undertaken and their approximate durations in between each of these five "benchmark" times, subject to the condition that all minutes in the day were accounted for.

Once this was completed, the enumerator asked the respondent if she had undertaken specific activities which she might have forgotten about and had not mentioned. If such an activity was identified, then the original sequence and duration of activities was appropriately amended. Again, the reasonable patterns demonstrated by these time allocation data, which are consistent with variations in average landholdings across the various crop tenancy groups, with the different cropping patterns of corn and sugar households, and with whether or not an infant was being nursed, argues that a sufficiently large and sufficiently accurate time allocation data set was collected to conduct a credible analysis.

Apparently successful implementation of these two components of the survey instrument depended on the availability of highly trainable and motivated enumerators and relatively well-educated and willing respondents, who understood at least to some limited degree why these data were being collected. These conditions are easier to fulfill in the Philippine context than in other countries. With respect to the

individual calorie intake data, it is the usual custom that individuals eat from their own separate plates of food, which undoubtedly makes recall easier for the mother and more accurate, than in cultures where individuals eat directly from a common pot. With respect to collection of time allocation data, there is a general awareness of what time it is at any given point of the day. It is not uncommon to own a watch. Meetings and church services are designated to begin at particular times, as are radio programs. In other cultures, where such awareness of the time may be lacking, the methodology described above could not be successfully implemented. With these caveats, then, and despite the potential problems associated with collection of calorie intake and time allocation data using recall, the present study demonstrates that these data can be successfully collected and can provide useful analysis in particular situations for a large enough sample.

AREAS FOR FURTHER RESEARCH

In proposing new areas for research, the discussion is divided into those topics that can be researched with the data already available and those topics that would require additional data collection. One of the advantages of collecting such a comprehensive data set is that it may be analyzed from several different policy perspectives. We focus here on land reform, population growth, small-scale pig and chicken production, and backyard vegetable and fruit production.

Much of the analysis presented in this report is disaggregated by land tenure group and some of the implications of these results for land reform policies will be discussed below. However, there is still

much more analysis that could be done on this topic with the data. It is as yet undecided what specific criteria will be used to redistribute land, under land reform legislation being discussed by the Philippine Congress. For example, what is the maximum amount of land that a single owner will be allowed to retain, and upon subdivision of farms larger than this maximum, what is the minimum amount of land that will comprise each subdivision? If tenants are already working the land to be subdivided, this may involve a relatively simple transference of ownership. In other cases, it may involve giving land to households that were previously landless.

Under various alternative arrangements, then, households will experience a significant shift in the resources available to them. Consequently, there will be a significant change in the way that these households allocate their resources, resulting in changes in what these households supply to and demand from various markets. What will happen to supply and demand for agricultural labor, demand for credit, demand for agricultural inputs and output supply? How will consumer demand patterns shift? To what extent will the nutritional status of low-income groups benefit under various scenarios for minimum farm sizes? To what extent can nonagricultural employment be expected to augment incomes of landless or near landless rural groups?

Because production and consumption decisions are undertaken simultaneously given the resources available to the household, these questions can only be addressed with the type of household data collected for this study. Production, consumption, and nutrition data are available for a wide range farm sizes and tenure arrangements which

may be compared and contrasted in much the same way that corn and sugar households have already been compared and contrasted.

We have seen that the switch to sugar altered household time allocation patterns. As opportunity costs of particular activities changed for various individuals, was there a corresponding shift in fertility decisions? Similarly, is fertility affected by differences in farm sizes and tenure arrangements? The data set includes a complete reproductive history for the mother, including dates of miscarriages and ages and causes of death of deceased children. Although sugar may have been introduced recently enough that it may be difficult to measure changes in fertility after so short a period, some information is available on household landholdings and tenure arrangements for the seven years previous to the detailed surveys.

There is very little data available on livestock production in the Philippines. Yet, if the Philippine economy recovers and the incomes of middle- and low-income groups increase, the livestock sector could become one of the fastest growing sectors of the rural economy because of rapidly growing demand for meat (see Bouis 1987). Corn, of course, is an important input in livestock production. Most of the recent growth in livestock production during the 1970s was accounted for by large pork and poultry commercial establishments set up near Manila. What information there is indicates that feed rates are much higher in these commercial establishments than for small-scale producers.

If the rapid growth in demand for meat actually materializes, can small-scale pork and chicken production satisfy a significant portion

of that demand? What are the constraints to increased small-scale production? Can small-scale production compete effectively with commercial production? Could this small-scale production provide an important and growing source of income for corn farmers? A fairly complete set of data were collected on livestock inventories, prices, labor, feed inputs, sales, and home consumption of all livestock products for all of our respondent households. These provide some basis for analyzing the above issues.

The comment is often made by the casual observer that if the poor only had the resources to maintain a small garden plot on which they could grow vegetables and other foods, much of the malnutrition problem could be eliminated. Most of our respondent households had such plots, even those households classified as landless. For some households, these plots were relatively substantial and provided a significant amount of additional income, while for other households they were only marginal in their size and impact on household consumption. *Ceteris paribus*, is nutrition better in households that maintain these plots? Why do some households maintain such plots, while others do not? What determines what is grown on these plots, and what are the constraints to increased production? Again, fairly detailed data were collected on prices, labor, inputs, sales, and home consumption from these plots, which could be used to look at these issues.

Finally, what data were not collected that could have added to our understanding of the nutrition effects of the switch to sugar production? Perhaps, the most important missing data are adult energy expenditures, which are difficult and expensive to estimate. As

discussed in Chapter 8, the calculation of the calorie adequacy ratios, which are the basis for the conclusion of a skewed distribution of calories within the household, assumed the same moderate activity levels for all persons. However, one can presume that a landless agricultural laborer, for example, expends more energy than a large-holder sugar farmer who spends most of his time supervising hired laborers. But what is the magnitude of the difference in these expenditures? Is the agricultural laborer perhaps willing and physically able to work longer hours, but has difficulty finding employment so that the energy he expends on average is not so high after all? Alternatively, is the labor that he undertakes so strenuous and his calorie intake so low, that he is not physically able to work as many hours as there is employment available? Answers to questions like these would perhaps go a long way toward explaining the intrahousehold distribution of calories seen in Chapter 8.

NATIONAL NUTRITION POLICY FOR AGRICULTURAL HOUSEHOLDS

Raising household incomes appears to be a necessary, but not a sufficient condition for improving 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.

However, none of the measures that were tried of formal education, nutritional knowledge, or experience had any consistently beneficial effect on nutrition at multiple links in the four-stage system that was estimated. For the whole sample, years of education of the mother was significant only in increasing food expenditures, the first link in the four-step system. This suggests the possibility that these mothers have the right idea in the sense of buying more food, but perhaps because of misinformation they are targeting more expensive, but nutritionally less useful nutrients such as proteins. Data not presented in the report show that preschoolers even at low incomes are consuming recommended levels of proteins. Adding protein intakes to the Z-score regressions in Chapter 9, results in nonsignificant coefficients for this variable, although it is significant when it replaces calorie intakes in the regressions.

At the crucial second link in the four-stage process, where much of the "leakage" occurs in terms of increases in income not being transmitted into increases in preschooler calorie intakes, no measure of education, knowledge, or experience is significant. R-square values are low for this key equation, which is to be expected because of random day-to-day variation in calorie intakes. Few variables are significant, although municipal population density, intended as a proxy for availability of processed and packaged foods in the markets (imported from outside Bukidnon), decreases calorie intakes controlling for food expenditures.

For the sample as a whole, intrahousehold distribution of calories improves with the age of the mother, intended as a proxy for her experience. This variable is also positive and significant in the ZWL regressions. In the ZHA regressions, which measure the effects of variables on nutritional status in the long run, years of education of the father is significant for all three samples. This suggests that in the parental bargaining process of deciding how to allocate time and other resources, it is important that both mother and father be aware of the nutritional implications of their decisions on their children.

Improvement of preschooler calorie intakes, however, may not be a sufficient condition for substantially improving nutritional status because of the high prevalence of sickness, even among high-income groups. Reducing illness may involve both education and improving community-level health and sanitary conditions. Exploratory regressions with sickness, fever, and diarrhea as dependent variables, however, provide little guidance in this area. Preschooler age and birth order are positively and significantly related to better health, but these are hardly amenable by policy action. Having improved water facilities is positively and significantly related to the prevalence of diarrhea, while having electricity increases the prevalence of fever, both opposite signs than had been expected.

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, even for households that appear to be able to purchase higher amounts of calories without substantially increasing food expenditures, a priority area of action

would be to introduce pilot nutrition education programs in an attempt to determine if 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 fact that there were no government extension programs to teach farmers how to grow sugar, no government credit programs to help farmers out with the much higher fixed costs of initiating sugarcane production, and no 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 onto their land realized substantial increases in their net worth. Higher incomes meant that these households could eat more varied diets, provide a better education for their children, enjoy better housing, and many other benefits that usually accrue to having a 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 they got older, preschoolers were not able to sustain their initial height gains, so that by the time they reached three and four years of age, they were no taller than their corn household counterparts. For whatever reasons despite the higher incomes of their parents, they were eating no better than corn household children and were getting sick more often.

Unfortunately, the numbers in Chapter 3 indicate that for each sugar landowner and renter household that benefited in the ways just mentioned, there was a household that lost access to land, and that consequently experienced a decline in income. Thus, there was also a substantial number of households that were losers in the process of commercialization studied here. As a result, these households had less varied diets, could not provide as good an education for their children, had worse housing, and so on. By the time they reached the ages of three and four, 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.

Furthermore, the data from both the initial random survey discussed in Chapter 3 and the detailed households surveys themselves indicate that it was the smallholders with relatively large landholdings that were able to overcome the barriers to adoption and initiate sugarcane production. Given the current interest in the Philippines in a more equitable distribution of income in rural areas through land reform, an important question to ask is what were the fundamental, 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 in a sense "pushing" landowners and tenants off the land. Returns to household labor and other inputs are quite low, so that if more attractive income-earning opportunities become available to corn-growing households elsewhere, the decision to leave the land is made much easier. Second, the better ability of the larger farm households to bear risk, their better access to credit facilities, 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, then these advantages of the larger farm households constitute a force in a sense "pulling" less well-endowed households off the land.

DEVELOPMENT STRATEGY FOR MINDANAO

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. This is an obvious advantage for any type of agricultural production, but for fruit-bearing trees, this is particularly important in that strong winds can destroy an entire harvest by blowing away flowering buds. Typhoon winds can uproot rubber trees because of its shallow roots, so that Mindanao is the only region where rubber can be grown in the country. Second, sunshine and rainfall are more evenly distributed throughout the year in Mindanao than in Luzon (which is subject to heavy monsoon rains and afterwards a relatively

long dry season), which is conducive to more continuous agricultural producton throughout the year.

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 has been some open land for expansion. Mindanao is well situated, then, for generating the high agricultural growth rates that policymakers at the highest levels have continued to insist will be the backbone of the economic recovery in the Philippines. 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? To help to prevent a further deterioration in land distribution patterns, first, 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. 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 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 forego corn production.

Second, at the same time the government needs to make a conscious effort 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, *ceteris paribus* the government should seek to promote export crops which 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.

APPENDIX 1

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

Table 7.1 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, the 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

First, while theoretically total expenditures plus savings should sum to income, how do the data for these two variables actually compare? On average for the total sample, per capita income is slightly below 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 and positive savings for the total sample. 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, where the mark-up between retail and farmgate prices was 25 percent (numbers not untypical for corn share tenant households), would give an estimate of income which was a minimum of 8 percent higher (profits go up by more than 25 percent, the percentage amount depending on the difference between the output price and production costs). Despite this shortcoming, average incomes are essentially equal to average total expenditures, which is an improvement over other studies that have attempted to measure both variables and typically come up with estimates of income that are well below total expenditures.

Comparing incomes and total expenditures for the various crop and tenancy groups given in Table 7.1, 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, an alternative interpretation is that the accumulation of debts obviously cannot occur indefinitely, so that an understatement of income for low-income groups is probably overstating the accumulation of debts.

Elaborating this alternative further, certain socially obligatory income transfers to extended family members or other dependents are

perhaps easy to pick up on the expenditure side, but not 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 TOTAL EXPENDITURES TO CLASSIFY HOUSEHOLDS

Second, in order to obtain a rough estimate of the income elasticity of household calorie consumption from the two-way table as an intuitive check against later regression results, what is the dispersion in incomes and expenditures between low and high income groups? Disaggregating by *income* quintile in Table 7.1, incomes increase by a factor of 7.7 from 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 the one side of the distribution and underestimates to the opposite side. This is a particular problem at the tails, while for middle groups overestimates and underestimates will tend to even out (note from Table 7.1 that for

both the *third income* and *third expenditure* quintile, estimates of income, total expenditures, and food expenditures are nearly identical). Despite this, economic data are often presented in this manner and discussed, 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) is likely be *understated*. 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 with the expenditure data 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 ten 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 provides a framework, then, for an intuitive understanding of the different patterns of dispersions obtained above when disaggrega-

ting by income quintile and by expenditure quintile in Table 7.1. More importantly, however, we can begin to state some rules 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) by obtaining measures of the dispersions of two variables by stratifying by each of the variables, estimates can be obtained which "bracket" the true dispersion.

To illustrate the use of the third rule, making use of the first rule, ratios of income and total expenditures for the fourth and second income quintiles and fourth and second expenditure quintiles are computed as shown in Table A.1.

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 two, 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, our data indicate that persons in the second income/expenditure quintile spend considerably more than they earn while persons in the fourth income quintile break about even. Using percentage increases closer to those

Table A.1--Income Elasticities of Household Calorie Consumption implied by Two-Way Relationship Shown in Table 7.1

Categories Across Which Elasticities Are Calculated	Ratio of Incomes	Ratio of Total Expenditures	Ratio of Calorie Availability	Ratio of Calorie Intakes	Implied Elasticity			
					Income		Total Expenditures	
					Calorie Availability	Calorie Intake	Calorie Availability	Calorie Intake
Fourth and Second Income Quintile	1.908	1.345	1.190	1.047	0.21	0.05	0.55	0.14
Fourth and Second Expenditure Quintile	1.773	1.681	1.254	1.054	0.33	0.07	0.37	0.08
Corn Owner And Corn Laborer Households	1.795	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

generated by the income quintile breakdown give even higher marginal rates of saving. The expenditure quintile breakdown seems to give more reasonable estimates.

CALORIE AVAILABILITY VERSUS CALORIE INTAKES

Third, 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 7.1 all understate the true dispersion. Nevertheless, since expenditure data are measured more accurately and did not seem to bias the income and expenditure dispersions too much, 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 A.1). Which data source is more accurate?

Comparing 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 intake occurred for the third survey round 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, both elasticity estimates are below 0.10. At average income levels for the sample households, analysis of the data from the two-way table 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 7.

CONCLUSION

An important objective of this discussion has been to show that because total expenditures (in large part) and calorie availability (in its entirety) are both constructed from food expenditure data, there is