INCOMES AND FOOD SECURITY IN GHANA

Harold Alderman*

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ABBREVIATIONS

FAO	Food and Agriculture Organization
GLSS	Ghana Living Standards Survey
PPMED	Policy Planning, Monitoring, and Evaluation Department (Ministry of Agriculture)

FOREWORD

This working paper is the third in a series on food security and nutrition in Ghana, and follows from Working Papers 1 and 10. Numerous issues are discussed in this paper, which provides detailed information that will enable the formulation of appropriate food security and agricultural strategies for Ghana. As the author, Harold Alderman, points out, the findings of wide-ranging analysis confirms prior expectations and contradicts some widely held notions. The results of the analysis of seasonal price variability, substitution between crops, the efficiency of markets, sources of income, and storage and sales behavior of households are of great interest. But of particular importance is that the paper discusses issues regarding the role and implications of alternative growth and agricultural strategies for food security. Alternative policies are not neutral for food security outcomes. This paper supplies information on the characteristics and behavior of households and markets; this information is relevant to food security and should be incorporated into the decisionmaking process. In fact, the types of insights provided in this paper will promote a sound policy framework required to both continue Ghana's successful efforts at economic restructuring, and to ensure that the poor are included among the beneficiaries. Therefore, this work is an important contribution to CFNPP's research on the impact of economic reforms in Africa on poverty, food security, and malnutrition, which in the case of Ghana, is jointly sponsored by a Cooperative Agreement with the Africa Bureau and Ghana Mission of the Agency for International Development, as well as the World Bank.

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David E. Sahn
Deputy Director, CFNPP

1. INTRODUCTION

Most studies of food security begin with a definition of the term. This is not merely a convention or an author's groping for an entry point. Nor is it only to establish a common ground and prevent unnecessary debate, useful though that may be. One begins with definitions and subdivisions because the methodology for analysis — and ultimately the interventions that are attempted — are based on the point of view. Taking as a common ground the definition of food security as the access by all people, at all times, to enough food for an active, healthy life, one can then follow Reutlinger and van Holst Pellekaan (1986) in distinguishing transitory and chronic dimensions to this insecurity. Similarly, Iliffe (1987) analyzes poverty in Africa in terms of structural and conjunctural poverty. In another context, Sen (1981) distinguishes between what he defines as entitlement failure — roughly a loss of earning power or exchange value — from food availability declines as factors in famine.[1]

While recognizing the policy relevance of such distinctions, it is also useful for the goals of this study to make a different distinction, between household and market-level food security. Both of these categories have transitory as well as chronic dimensions; they differ mainly in the arena of interventions (see Figure 1). To be sure most, if not all, households utilize markets for a portion of their consumption as well to enhance their incomes. Household strategies to mitigate risks, however, differ from government's strategies to stabilize markets. Moreover, the tools a government has with which to intervene in markets require different administrative techniques than household-level interventions. For example, market interventions can, to a degree, be targeted to a region or a commodity (which may implicitly target specific income groups) with comparatively less administration and relatively more economic distortions than expected when programs are targeted to households.[2] The techniques used to analyze such food policy measures also depend to a large degree on the orientation and type of interventions under consideration (Timmer, Falcon, and Pearson 1983).

Disaggregation is clearly the key to analysis of food security issues. Dreze and Sen (1989), for example, indicate that entitlement failures (transitory shocks to incomes) often are not strongly correlated in a region. Households with different income sources are affected diversely in the face of weather or

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1 While it is not necessary here to review the many debates that Sen's (1981) book engendered, it is useful to mention that Sen does not use these concepts as mutually exclusive.

2 Targeting is discussed in Rogers (1988).

Figure 1 — Ghana: Dimensions of Food Security

	Transitory	Chronic
Household Level	Income and Savings Shortfall Entitlement Failure Health Shocks	Insufficient Assets (Including Education and Human Capital) Intrahousehold Resource Sharing
Market Level	High Food Prices Food Availability Decline	Long-Run Relative Prices and Wages

pest-induced shocks, or in light of changes in policies and market conditions. Similarly, aggregation of food availability on a national level is a poor indicator of household nutrition in the face of income inequalities or barriers to interregional trade. Household food availability, in turn, may mask inequity of consumption within the household.

Another key to the analysis of food security is the distinction between levels and variability, as implied by the distinction between chronic and transitory. Thus, Staatz, d'Agostino, and Sundberg (1990) can find that anthropometric status is correlated with household food production in the north of Mali, yet also observe that the region has evolved more diverse nonagricultural income sources to cope with the uncertainty of cropping in the environment.

The analysis that follows uses a sample of 600 households in two regions of Ghana to depict household strategies as they pertain to food security.[3] One region, the Upper East, is one of high population density and low agricultural potential. The other, Brong-Ahafo, is a major source of marketed food for the country. The former is in the drier part of the savannah in Ghana, while the latter stretches from the moist savannah south into the forest ecological zone. Together, then, they depict a fair range of economic and agricultural possibilities facing households in Ghana. To be sure, no two regions — and no cross-sectional data set — provide a full picture of household food security patterns and responses for an entire country. The analysis, then, is augmented with data from the 1987-1988 Ghana Living Standards Survey (GLSS), a nationwide, self-weighted survey covering 3,000 households, as well as other published information from neighboring countries (see also Alderman and Higgins [1992]). Moreover, the paper is meant to serve as a companion to a study of market prices (Alderman and Shively 1991) to indicate other dimensions of food security.

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[3] This survey will be referred to as the Cornell-Fudtech survey in the remainder of the paper.

2. INCOMES

REAL WAGES

While wage indices provide a reasonable indicator of trends in earning power, there are only a few countries for which price and wage series reflect the position of low-income households. Alternatively, from the perspective of food security, one can use the amount of food an unskilled worker can purchase with a day's wage as an indicator of real income. While no single food commodity is a precise deflator of wages, the number of kilos of grain obtained for each day of employment provides a tangible indicator of purchasing power. This statistic has the additional advantage of allowing some accessible intercountry comparisons.

Table 1 indicates the ratio of the minimum wage to the price of maize — often, but not always, the cheapest source of calories (Alderman and Shively 1991). The June and December prices are reported for four markets, although the major source of variation is over time and not spatially.[4] Figure 2, then, presents the same information graphically for one of these markets, Kumasi, for which there are no missing observations in the period.

The minimum wage was revised in eight of the ten years covered. It nevertheless could neither adapt to the June seasonal price rise, nor always keep pace with inflation. Clearly, it was an insufficient basis for subsistence for an individual during the drought of 1983. Moreover, given that a kilogram of maize provides roughly 1.5 times the calorie requirement of an adult, in many years in the decade the wage rate was insufficient for an individual to adequately support dependents. While the situation improved in 1985, the minimum wage then eroded until 1989. Even at its peak during the decade, the wage fell well below the level in the middle of the 1970s. For example, in 1975 the minimum wage would purchase between 6.0 and 7.5 kilos of maize depending on the market and month.

Although it is a diversion from the main theme, it is of interest to compare the purchasing power of unskilled labor in other countries (Table 2). Braudel (1981) presents a graph indicating the amount of wheat that could be purchased per 100 hours of work in two French markets between 1401 and 1950. The figure in Braudel's book depicts a number of periods of sharp increases in the amount of labor necessary to obtain wheat. Of greater pertinence to the theme here is

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[4] Unless indicated, all commodity prices are from Policy Planning, Monitoring, and Evaluation Department (PPMED) price series for the respective markets and years.

Table 1 — Ghana: Minimum Wages in Terms of Kilograms of Maize That Could Be Purchased with a Day's Wages

		Accra	Bolgatanga	Kumasi	Techiman
1975	June	—	7.77	—	—
	December	—	6.67	—	—
1980	June	0.75	0.69	0.64	0.71
	December	0.87	2.50	1.03	—
1981	June	1.22	1.32	1.14	2.00
	December	1.60	1.92	2.06	2.40
1982	June	1.10	1.16	1.20	1.71
	December	—	1.99	1.11	1.50
1983	June	0.51	0.33	0.28	0.58
	December	—	0.82	0.74	0.98
1984	June	0.98	1.06	0.97	1.08
	December	2.90	2.15	4.05	5.09
1985	June	3.12	2.99	2.98	3.94
	December	2.67	3.84	3.21	3.85
1986	June	1.71	2.62	1.88	2.12
	December	2.17	3.54	2.36	2.81
1987	June	1.03	1.65	1.10	1.37
	December	1.37	1.53	1.41	1.73
1988	June	1.05	1.25	1.11	1.31
	December	1.90	2.08	2.22	2.71
1989	June	2.47	3.09	3.62	4.55
	December	2.91	3.32	3.82	4.02
1990	May	1.83	3.45	—	2.57

Sources: Maize prices from PPMED regional price data; minimum wages from Alderman (1991).

Figure 2 — Ghana: Minimum Wage in Maize Equivalents, 1980-1989 (Kumasi)

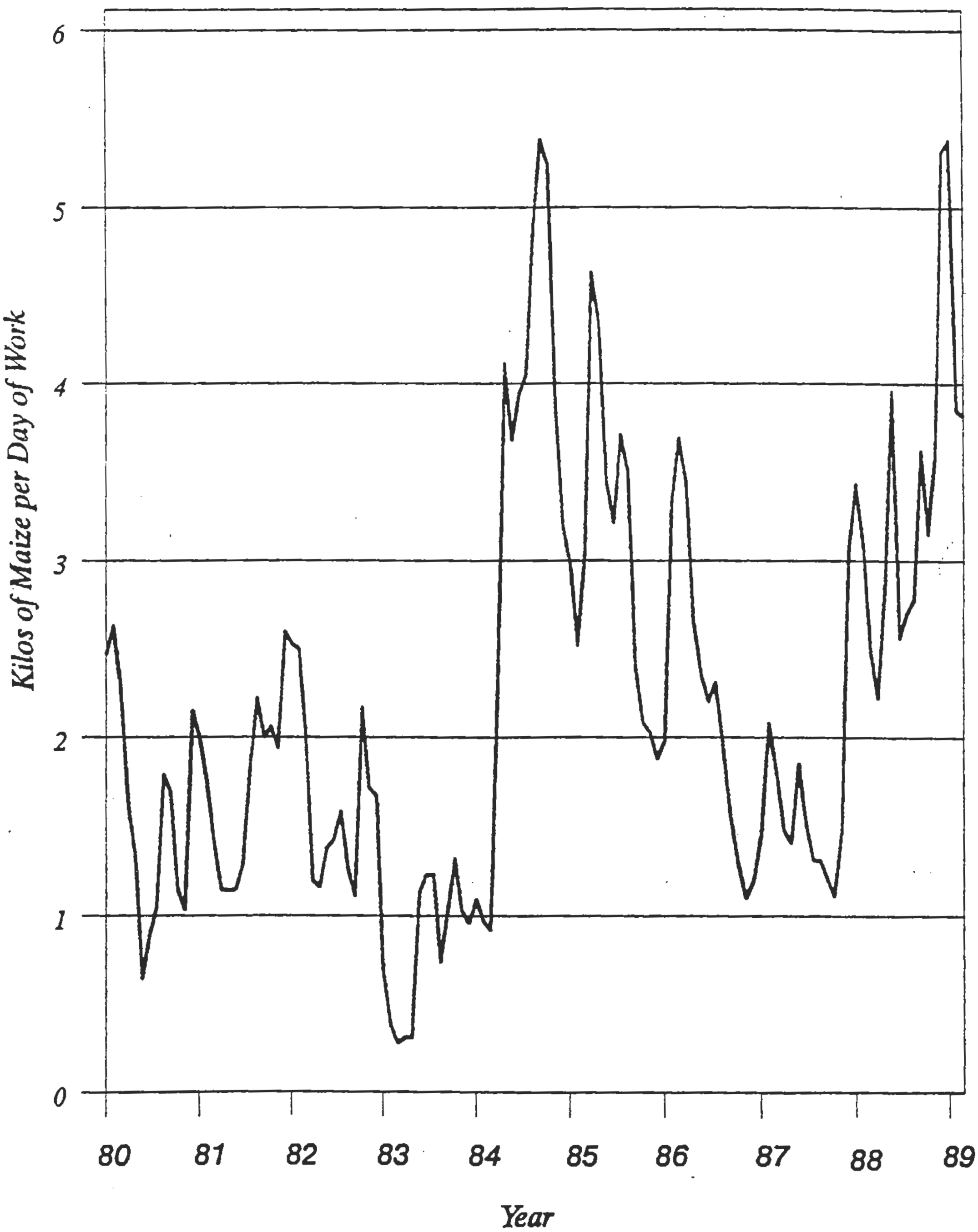

Table 2 —International Comparison of Grain Equivalent of Wages

Country	Year	Grain Equivalent	(Commodity)	Type of Wage
Africa				
Burkina Faso	1989	10.0	(Maize)	Minimum wage
Egypt (Cairo)	1982	33.4	(Bread - dry weight)	Average wage
Egypt (rural)	1982	20.0	(Unrefined flour - official price)	Wage of unskilled worker
Ethiopia	1988	4.4	(Maize)	Rural wage[a]
The Gambia	1989/90	3.3	(Rice)	Minimum government wage (menial)
Madagascar	1987	2.1	(Rice)	Minimum wage
	1977	5.3	(Rice)	Minimum wage
Malawi	January 1988	2.4	(Maize)	Minimum wage
	January 1989	3.3	(Maize)	Minimum wage
Mozambique	August 1990	4.1	(Maize meal)	Minimum wage
	August 1988	2.8	(Maize meal)	Minimum wage
	August 1987	6.0	(Maize meal)	Minimum wage
Zimbabwe	1991	9.2	(Maize meal)	Minimum casual worker wage
	1991	4.1	(Maize meal)	Drought relief wage
Asia				
Bangladesh	1988	3.6	(Rice)	Average rural wage
	1973	1.9	(Rice)	Average rural wage
Bangladesh	1988	5.8	(Wheat)	Average rural wage
	1973	3.4	(Wheat)	Average rural wage
India (Tamil Nadu)	1985/86	2.6	(Rice)	Wage for ploughman
Indonesia (East Java)	1986	2.8	(Rice)	Wages for hoeing
	1976	1.4	(Rice)	Wages for hoeing
Indonesia (East Java)	1986	6.9	(Maize)	Wages for hoeing
	1976	2.8	(Maize)	Wages for hoeing
Pakistan (Karachi)	1986	12.4	(Wheat flour)	Average wage for unskilled laborer
Philippines (rural Mindanao)	1984-85	5.2	(Maize)	Average rural wage
	1984-85	3.7	(Rice)	Average rural wage
Philippines (rural Luzon)	1983-84	5.9	(Rice)	Average rural wage

[a] Market is very thin.

the fact that a pronounced secular trend is evident; it was not until the late 1800s that the real wage rose to the level that prevailed in France in the 15th century. In absolute terms, this level which Braudel — somewhat arbitrarily — claims is a dangerous ceiling is 1 kilogram of wheat per hour of labor. As a historical point, in only a few years in the entire period he studied did the grain equivalent of a day of labor in France fall to the level of the *highest* minimum wage in the decade in Ghana.

It should be noted that the minimum wage in a number of African countries is often as variable, and occasionally as low as those in Ghana. For example, in Mozambique it has ranged between 2.75 and 10.6 kilos of maize meal (at the official, controlled price) in the short period between January 1987 and the end of 1990. The trend during this period of structural adjustment was clearly downward. It was 4.1 kilos per day of labor in August 1990. Similarly, the maize equivalent of the minimum wage in Malawi ranged between 2.4 and 6.0 kilograms a day in the three-year span between January 1986 and February 1989. This is in sharp contrast to the high minimum wage in Burkina Faso, which has ranged between 9.7 and 15.0 kilograms of maize (7.8 and 18.0 kilograms of millet) per day of work.

Part of the explanation for this wide range comes from the fact that in some countries, few laborers actually receive the minimum wage; market wages are often less sticky, hence less variable, than official wages. In Burkina Faso, most wages are likely below the minimum. In Ghana, on the other hand, the majority of workers earn more than the minimum; less than 10 percent of all individuals who reported a wage in the 1987-1988 GLSS indicated that their wage was below the legal minimum (Table 3). The rate is only slightly higher — at 15 percent — for the small subset of those individuals who reported receiving a wage for agricultural labor. The Cornell-Fudtech survey results are essentially the same as in the GLSS.

Still, average wages in Ghana are low by international standards. The median wage reported in the 1987-1988 GLSS was 300 cedis, or 75 percent more than the minimum wage.[5] Even agricultural wages were 50 percent above minimum wages. This, then, implies 4 to 6 kilos of maize per day of wage employment depending on the season. While these are not famine levels,[6] they imply comparatively little leeway (in either a cross-country or a temporal perspective) for high dependency ratios, or little cushion for spells of either seasonal or structural unemployment.

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5 If the value of allowances and in-kind support is included, the median wage was 363, or twice the minimum.

6 As indicated, for example, in Table 1 with the low wages in June 1983. This level is lower than that in the nadir of the disastrous Bengal Famine of 1943, when a day's work, if available, would purchase 0.6 kilogram of rice (Sen 1981).

Table 3 — Ghana: Percent of Wage Earners Below Minimum Wage

	Agricultural	Nonagricultural
1987-1988 (GLSS)		
Rural	15.7 (51)	11.1 (307)
Urban	8.8 (34)	6.1 (573)
May 1990		
Brong-Ahafo and Upper East regions	14.9 (47)	4.5 (132)

Sources: GLSS 1987-1988 survey and Cornell-Fudtech 1990 survey.

Note: Number of total observations in parentheses.

SOURCES OF INCOME

Although wages may be low in Ghana relative to the subsistence needs of a household, few households in the survey site relied exclusively on wages or on one wage earner. This touches upon two important points for the consideration of food security. First, rural is by no means equivalent to agricultural. For example, a recent cross-country study indicates that, in any given region, the rural poor on average may earn a high percent of earnings from nonagricultural wages and own-enterprise activities (von Braun and Pandya-Lorch 1990).[7]

Second, even when the overall contribution of wage or nonfarm, own-enterprise earnings is small, such earnings can be important both to reduce overall household risk and to even the annual flow of earnings. It is well known that the cropping pattern of small farmers in West Africa is based on a risk-reduction strategy. This strategy can be augmented by wage employment and migration, with diversification of income sources often increasing with the riskiness of agriculture. This is illustrated, for example, for Burkina Faso by Reardon, Matlon, and Delgado (1988) as well as by Staatz, d'Agostino, and Sundberg (1990) for Mali. In another context, Tripp (1981) finds that children from households with trader income in Northern Ghana had better nutrition than other households, although this result may also be influenced by differences in intrahousehold control of income.

Table 4 indicates the sources of earnings of households in the two regions. While there are a few differences in the overall earnings patterns of the two regions, these differences pale by comparison with the vast difference in levels of earnings. Average household income in Brong-Ahafo is nearly four times that in the Upper East; it is still three times as large when compared in per capita terms. Nevertheless, the share of earnings from wages or agriculture differs only slightly. Similarly, the additional support that comes from relatives and friends in the form of remittances is roughly proportional to total income and, therefore, is between 5.5 and 6.0 percent of total incomes for both regions.

Crop cultivation provides over half the total earnings reported from the sample in both regions. From another perspective, however, more than 40 percent of income is generated by activities outside of agriculture. This observation holds even if the small share of the sample (6 percent) which does not participate in agriculture is excluded.[8] The conclusion that nonfarm activities are important, even in these predominant rural regions, is relatively unaffected even if livestock earnings are aggregated with agriculture.

Although no single nonagricultural income source dominates the earnings profile, collectively the importance of these sources reinforces the view that

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[7] See also Haggblade, Hazell, and Brown (1989). Among the 15 studies of nonfarm income in rural Africa they cite are 4 studies from Ghana that indicate nonfarm income shares between 14 and 75 percent.

[8] Even urban residents in the sample often cultivate some land.

Table 4 — Ghana: Sources of Income, by Region

	Components of Annual Income	
	Upper East	**Brong-Ahafo**
	Percent	
Agriculture	54.4	57.0
Livestock	9.9	4.4
Wages	12.8	13.9
Sale of forest products	6.1	2.6
Sale of crafts	3.2	7.7
Sale of food and beverages	4.7	7.3
Other income	8.9	7.1
Total	**100.0**	**100.0**
Earnings (Cedis) plus remittances (percent)	149,307 (5.6)	540,450 (6.1)
Total earnings (Cedis)	**157,683**	**573,790**
N	300	298

enhancing linkages between agriculture and rural nonfarm earning opportunities is an integral component of development strategies. The data from this survey, moreover, are reinforced by similar results from the GLSS data, despite an apparent underreporting of nonfarm own enterprises in that survey. Moreover, the percentage of income from activities other than livestock and crop production in the Upper East is actually less than observed for the neighboring Guinean zone of Burkina Faso. Reardon, Matlon, and Delgado (1988) indicate that *farm* households in this region earned 43 percent of their incomes in a three-year period from off-farm activities.

There are some regional differences in earning patterns compared to Brong-Ahafo: livestock earnings are twice as large as a share of earnings in the Upper East, as are sales of forest products (including charcoal as well as shea nuts). Note, however, that in both examples, the total value (as opposed to the share) is higher in the more prosperous region.

With greater disaggregation, more regional patterns are found, particularly with regard to cropping patterns. Most of the rice grown, as well as virtually all of the millet and sorghum, was cultivated in the Upper East. Yams, cassava, plantains, and cocoa, on the other hand, are only found in the Brong-Ahafo sample.

Such regional differences in cropping patterns as are indicated in Table 5 are well known to anyone with a basic familiarity with Ghana. Nevertheless, it is worth discussing their implications at greater length. The principal observations that come from studies of relative (or absolute) poverty in Ghana tend to revolve around regional and ecological distinctions, or the cropping patterns that stem from the geographical differences (Oti-Boateng et al. 1990).[9] Similarly, Alderman (1990) indicates that malnutrition is significantly higher in the savannah zone, even after differences in expenditures are considered. While these two studies are based on GLSS data — that is, on a survey that was not designed for disaggregation on a regional or district basis — various crop management and similar micro studies support the view that interregional income disparities are as great, if not greater, than intraregional differences.

The Cornell-Fudtech survey, then, with its concentration on two regions, adds to this understanding not only because it presents specific data on the sampled regions, but also because it indicates the magnitude of income disparities even over a comparatively small geographic area. The ecological basis of income disparities is also indicated by the large coefficient of cocoa

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9 To some degree this is masked by aggregation. Appendix Table 4 uses GLSS data to show cropping by agroecological zones and expenditure quintiles. Note that the number of households in the poorest quintile is greatest in the savannah. The number of households in that zone producing plantain, however, is a clear indicator that the zones used by the Statistical Service Office do not correspond strictly to agricultural usage. Such a table, then, can only give a rough indication regarding the nature and amount of interregional, as opposed to intraregional, income disparity.

Table 5 — Ghana: Regional Cropping Patterns

Crop	Proportion of Output by Value		Sample Proportion Produced in Upper East	
	Upper East	Brong-Ahafo	By Value	By Number of Households
Maize	4.7	11.6	8.3	17.5
Sorghum	24.0	0.2	97.1	92.1
Millet	25.6	0.2	96.7	96.6
Rice	13.2	3.5	45.0	81.1
Yam	—	36.0	0.0	—
Cassava	—	5.2	0.0	—
Cocoyam	—	5.9	0.0	—
Groundnuts	17.9	2.1	65.0	80.4
Cowpeas	5.6	1.7	42.4	72.2
Cotton	0.4	0.2	33.5	46.1
Tobacco	1.6	0.1	23.8	57.1
Vegetables	6.5	8.2	14.3	46.8
Plantains	—	3.5	—	—
Cocoa	—	17.1	—	—
Other	0.5	4.2	—	—
Total	**100.0**	**100.0**		
N	300	298		

Source: Cornell-Fudtech 1990 survey.

area owned in a multiple regression relating income in the sample to assets, including human capital and household labor (see Appendix).

Such data suggest that incomes are predominantly geographically determined and, as such, not easily accessible to policy. This interpretation, however, would be an overstatement; to a degree, regional disparities reflect past biases in investments and, hence, are responsive to changes in those patterns. The differences in cropping patterns indicated in Table 5, for example, suggest priorities for equity considerations in agricultural research. To be sure, such considerations need to be weighted with more conventional efficiency criteria. It should be noted, however, that crop-specific estimates of marginal returns to research are rarely precise enough to allow for a quantitative assessment of equity and efficiency tradeoffs.

Currently, research on cocoa, a crop that contributes roughly 15 percent of total agricultural GNP, receives 44 percent of the research budget and 75 percent of public current expenditures on agriculture (Mink 1989). Given the known north-south gradient of incomes, nutritional status, and food security by various measures, there is clear justification for considering the distributional consequences of research on sorghum and millet, as well as cowpeas and groundnuts.

The distributional and, hence, food security consequences of crop research can also be a consideration with respect to crops such as rice, which is grown in both the northern savannah and forest zones. As is indicated in Table 5, more households from the Upper East in the Cornell-Fudtech sample grew rice, yet more of that crop was produced in Brong-Ahafo. This reflects both lower yields in the northern savannah for this particular crop, compared to the forest zone, as well as appreciably smaller plots. In general, however, yields do not differ appreciably between the two districts — even for maize, which is relatively new and marginal in the Upper East — although farmers in the Upper East generally plant much smaller areas to any one crop than is reported for Brong-Ahafo. The different processes of production that this likely reflects also may imply a divergence of strategies between those which aim to increase production in the aggregate and those which raise incomes of the poorest producers.

As is often indicated in the large literature on the consequences of agricultural research, efforts to develop technologies for marginal environments often achieve objectives of poverty alleviation at the expense of faster growth of total output were those resources allocated to research for the most productive regions. It is a major research endeavor to weigh these considerations, especially as labor migration and linkages often carry progress in one region into neighboring ones. Nevertheless, from the food security and poverty standpoint of this project, it is useful to reiterate that when agriculture is considered as a source of income for low-income families, the consideration of who produces a commodity becomes an issue of importance in addition to the concern for how much is produced in the country.

Research policy, of course, is part of a larger nexus that includes price and other policies. Here too, there is potential for food security to be enhanced in the savannah, without necessarily concentrating on food crops. While the Cornell-Fudtech survey did not record much cotton being cultivated, this crop provides a significant source of earnings for savannah-based households in neighboring countries. That it does not also serve that role in Ghana is partially due to past policies. This neglect may be reversible over time.

Often there is an interest in disaggregating income sources by some measure of poverty. Various candidates for such groupings are offered in the literature, including income, expenditure per capita, and expenditure per adult equivalent. While some differences exist in household rankings by various measures (Glewwe and van der Gaag 1990), the group characteristics are less sensitive to the definition than are the rankings. The most comprehensive of such exercises for Ghana is the poverty profile reported by Oti-Boateng et al. (1990). That exercise does show a significant number of differences in cropping patterns, as well as expenditure patterns, between the poorest and the general population. As mentioned, however, GLSS data do not allow regional disaggregation. It is, therefore, not possible to clearly distinguish regional patterns from intraregional resource control with the results reported by Oti-Boateng et al.

The most dramatic result that is indicated in Table 6 is that, using income per capita as a measure of relative household welfare, the wealthiest income group in the Upper East is barely more prosperous than the lowest quartile for Brong-Ahafo. This may bracket the spectrum for rural incomes in Ghana, the Upper East being among the least prosperous and Brong-Ahafo among the wealthiest. In both regions there is a tendency for nonagricultural income to comprise a larger share of income as incomes rise. Conversely, one notes that income from the sale of food and crafts is comparatively low for the least prosperous group. This is perhaps a reflection of capital constraints, although this may also be due to an absence of access to roads and market outlets. Note also that wage earnings are highest for the more prosperous households, although the pattern is not uniform.

The absence of a strong intraregional pattern persists when households are classified as poor on the basis of *predicted* incomes' being less than that which is sufficient to purchase 80 percent of household calorie requirements, based on the observed income-calorie relationship discussed below. The patterns of production or income for poor as defined by predicted calorie consumption were found to be the same as the patterns for the lowest per capita expenditure quintiles in Table 6. Thus, there is no need to present a table on this former breakdown.

In order, however, to confirm the patterns in the Cornell-Fudtech survey, Table 7 indicates income shares of the poorest and wealthiest households in each agroecological zone as recorded in the 1987-1988 GLSS. There is one significant change in how the households are grouped relative to the original GLSS data; for the purposes of this table, the savannah zone includes only the Northern and

Table 6 — Ghana: Income and Assets, by Income Quintile

	Quartile							
	Upper East				Brong-Ahafo			
	1	2	3	4	1	2	3	4
Income per capita	15,868	17,837	28,548	37,298	32,254	45,236	74,625	109,683
Household size	7.7	7.2	6.0	4.7	10.6	9.3	8.6	6.8
Share of income from:								
Agriculture	60.1	64.2	54.1	43.1	61.5	60.4	55.3	55.7
Wages	10.7	6.8	15.5	16.3	9.7	14.2	15.1	14.1
Livestock	10.9	13.9	7.4	8.6	5.8	3.4	3.4	4.9
Sale of forest products	9.9	1.7	4.4	8.1	4.2	2.6	2.4	1.5
Sale of crafts	2.3	3.7	0.9	5.7	4.2	7.7	9.4	7.8
Sale of food	3.5	2.9	1.7	9.9	5.8	6.0	8.9	7.3
Other	2.6	6.8	16.0	8.3	7.8	5.7	5.5	8.7
Additional income from remittances (in percent of total income)	7.2	4.6	4.9	6.0	5.2	6.0	7.2	5.8
Irrigated acres	0.50	0.64	0.78	0.52	1.04	1.10	1.93	2.70
Cocoa area	—	—	—	—	1.67	3.01	4.41	8.35
Cows owned	3.19	2.59	3.84	2.32	0.35	0.36	0.12	1.29
Sheep/goats owned	5.00	7.16	8.89	6.50	5.77	6.65	4.81	7.13
Credit obtained in previous year	1,637	1,628	3,517	5,566	6,107	8,947	15,187	18,257
Percent of households receiving credit	13.3	17.6	18.7	19.2	30.7	30.7	30.7	30.7
N	75	75	75	75	74	75	75	74

Source: Cornell-Fudtech 1990 survey.

Table 7 — Ghana: Income Shares of Rural Households, by Agroecological Zone and Top and Bottom Expenditure Quintiles, Based on GLSS National Sample

	Coastal Zone		Forest Zone		Northern Savannah Zone[b]	
Income Share	Lowest 20%	Highest 20%	Lowest 20%	Highest 20%	Lowest 20%	Highest 20%
Agriculture	.60	.48	.68	.89	.91	.90
Maize	.17	.18	.11	.19	.12	.18
Rice	.01	.00[c]	.00[c]	.01	.06	.05
Millet/sorghum	.00	.00	.00[c]	.00	.47	.28
Roots/tubers	.28	.21	.44	.34	.14	.18
Cocoa	.02	.02	.07	.16	.00	.00
Other	.13	.15	.06	.06	.11	.18
Nonagriculture	.40	.52	.23	.32	.09	.11
Wage/salary	.05	.12	.04	.09	.00[c]	.02
Own account (nonfarm)	.29	.27	.15	.12	.09	.05
Other	.06	.14	.05	.11	.00	.04
Household income						
Total	**259,324**	**229,522**	**198,607**	**169,000**	**196,031**	**188,246**
Per capita	**34,706**	**106,386**	**24,814**	**85,077**	**19,603**	**57,057**
No. of households	102	103	186	186	60	60

Source: GLSS; incomes in 1987/88 cedis.

[a] Quintile ranks based on predicted per capita expenditures over households *within the zone only.*

[b] Northern Savannah consists of Northern, Upper West, and Upper East Regions only.

[c] Less than one percent when rounded.

Upper Regions.[10] Rankings are based on the relative position of household predicted per capita expenditure in each zone, rather than nationwide. There are some differences in the patterns observed in the GLSS data compared with the Cornell-Fudtech study. For example, the GLSS data have a lower share of nonfarm income compared with the Cornell-Fudtech survey.[11] The basic point that the differences in sources of income within a region are less than across regions remains supported with these data. The most pronounced difference between the highest and lowest quintile is in the coastal region which is not covered in the Cornell-Fudtech survey. There are, to be sure, large differences in per capita expenditures in all zones but relatively small differences in the *structure* of income, or even in the levels of households incomes.[12]

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[10] The more heterogenous definition of "savannah" used in the GLSS includes households that cultivate plantains, cocoyams, and even cocoa. This clearly reflects a larger geographic and agroecological base than conventionally assigned to savannah climates.

[11] Vijverberg (1990) discusses the strengths and weaknesses of GLSS own-enterprise data. Difficulties in recording this category in the first year led to subsequent questionnaire redesign.

[12] A reviewer commented that the cell means are reported in Table 7 (and elsewhere) without standard errors of the means. There are two ways of estimating ratios from grouped data. One can estimate income shares as

$$\frac{\sum_{n} y_{in}}{\sum_{n} \sum_{i} y_{in}}$$

or as

$$\frac{1}{n} \sum_{n} \left(\frac{y_i}{\sum y_i} \right).$$

The former is more accurate and is used in most tables, although the latter more readily gives standard errors. By illustration of the precision in Table 7, the standard error of the mean for the share of nonfarm income for each income group using the second method are .034 and .039 for the two coastal groups, .020 and .025 for the forest group, and .024 and .030 for the savannah. Similarly, using the latter method the means for the share of agriculture for the poorest and richest groups in the sample from Brong-Ahafo using the Cornell-Fudtech survey reported in Table 6 are 60.3 (3.3) and 44.0 (4.0). The poor do concentrate in agriculture significantly more than the well-off, although not more than the middle two quartiles. For the Upper East the corresponding means calculated in this manner are 67.8 (3.4) and 51.5 (4.7), again with the poor different from the richest quintile but not from the middle two.

Von Braun and Pandya-Lorch (1990) conclude that the differences in the sources of income between malnourished populations and other households within the same community are relatively small. This does not imply that incomes do not differ, but that many households have incomes that are diversified, with patterns that reflect the ecology. This is largely the case for the Cornell-Fudtech sample as well; all groups rely on nonagricultural as well as agricultural incomes. Differences in sources of agricultural incomes, moreover, reflect regional patterns more than within-regional distinctions. Moreover, even these differences — so pronounced with regard to income levels and per capita expenditures — require a fair degree of disaggregation before they become apparent.

INCOME VARIABILITY

As is indicated in Alderman and Shively (1991), the variability of individual commodity prices far exceeds the variability of the cost of the average diet. The coefficients of variation for various commodity prices are often in the range of 45 to 65 percent in selected markets in Ghana. The variability of the weighted price of 1,000 calories, using fixed calorie weights derived from observed consumption patterns (and hence overestimating the real variability) for these markets, is between 9 and 17 percent.

It is important to compare this variability with the variability of production, both in quantity and value terms. The purpose of this exercise is to indicate the relative magnitude of income variability. Ideally, this could be disaggregated by region or agroecological zone, but there is insufficient data for this in Ghana. Note, however, that there is a correspondence between crops and zones and, therefore, the data in Tables 8 and 9, which report coefficients of variation of production in quantity and value terms (as well as variances and covariances), respectively, also give a fair indication of regional income variance. Note that the variances reported in these tables are the variances of the residuals of trend regressions based on production between 1970 and 1989, using production data provided by PPMED. The regressions reported here were run with the dependent variables in levels, with time and time-squared on the right-hand side. This allows for more accurate modeling of the downward trend in production in the middle of the period. It should be noted, however, that the variance that is measured is the variance around this trend in production and not the departure from some trend in consumption, which is determined by income and population trends as well.

A few points can be highlighted from the tables. Although the savannah is a low-rainfall zone, the savannah crops, millet, sorghum, and yams, are actually less variable in quantity terms than many forest crops. As discussed below, however, the savannah cropping system as a whole is somewhat more variable than that in other zones. This reflects the fact that production of various crops is fairly correlated, with the exception of millet and the forest zone crops. Also, note that shortfalls in detrended cocoa production do not correlate strongly with any major crop. It can also be seen that, as expected, given the major

Table 8 —Ghana: Variance and Covariance of Detrended Production Quantities, 1970-1989

	Maize	Rice	Millet	Sorghum	Cassava	Cocoyam	Yam	Plantain	Cocoa	Coefficient of Variation
All years										
Maize	1.0000	0.7006	0.4322	0.4216	0.7064	0.6013	0.5656	0.4530	0.2564	37.0
Rice	0.7006	1.0000	0.2719	0.4460	0.4972	0.2920	0.4809	0.5017	0.4130	23.3
Millet	0.4322	0.2719	1.0000	0.5962	0.0177	0.0182	0.3225	-0.0916	0.2580	17.9
Sorghum	0.4216	0.4460	0.5962	1.0000	0.4341	0.2620	0.3057	0.2925	0.0852	17.2
Cassava	0.7064	0.4972	0.0177	0.4341	1.0000	0.7573	0.4362	0.6414	0.0680	23.9
Cocoyam	0.6013	0.2920	0.0182	0.2620	0.7573	1.0000	0.2536	0.5274	-0.2726	36.8
Yam	0.5656	0.4809	0.3225	0.3057	0.4362	0.2536	1.0000	0.1512	0.4288	25.1
Plantain	0.4530	0.5017	-0.0916	0.2925	0.6414	0.5274	0.1512	1.0000	-0.2152	33.7
Cocoa	0.2564	0.4130	0.2580	0.0852	0.0680	-0.2726	0.4288	-0.2152	1.0000	31.3
Excluding 1983										
Maize	1.0000	0.4855	0.3616	0.1111	0.5903	0.6635	0.4111	0.4796	-0.0283	33.3
Rice	0.4855	1.0000	0.1475	0.1974	0.2927	0.2267	0.3048	0.5165	0.2340	19.0
Millet	0.3616	0.1475	1.0000	0.5580	-0.1270	-0.0328	0.2415	-0.1401	0.1744	17.9
Sorghum	0.1111	0.1974	0.5579	1.0000	0.2506	0.1959	0.1115	0.2478	0.1485	15.3
Cassava	0.5903	0.2927	-0.1270	0.2506	1.0000	0.7739	0.2897	0.6518	0.1532	21.2
Cocoyam	0.6635	0.2267	-0.0328	0.1960	0.7739	1.0000	0.1942	0.5128	0.3862	34.8
Yam	0.4111	0.3048	0.2415	0.1115	0.2897	0.1942	1.0000	0.0920	0.3112	23.8
Plantain	0.4796	0.5165	-0.1401	0.2478	0.6518	0.5128	0.0920	1.0000	0.3083	32.8
Cocoa	-0.0283	0.2339	0.1744	0.1485	0.1532	0.3862	0.3113	-0.3083	1.0000	29.4

Source: Calculated from PPMED production data.

Table 9 —Ghana: Variance and Covariance of Detrended Production Value, 1970-1989

	Maize	Rice	Millet	Sorghum	Cassava	Cocoyam	Yam	Plantain	Cocoa	Coefficient of Variation
All years										
Maize	1.0000	0.6072	0.5613	0.7214	0.7907	0.2723	0.2070	0.6196	0.4876	41.9
Rice	0.6072	1.0000	0.4453	0.5483	0.4182	0.1327	0.1722	0.5373	0.4890	38.4
Millet	0.5613	0.4453	1.0000	0.8140	0.3760	0.4987	0.1919	0.2961	0.0664	35.7
Sorghum	0.7214	0.5483	0.8140	1.0000	0.4709	0.6050	0.0497	0.6501	0.2656	37.6
Cassava	0.7907	0.4182	0.3760	0.4709	1.0000	0.1234	0.4089	0.4499	0.4465	36.2
Cocoyam	0.2723	0.1327	0.4987	0.6050	0.1234	1.0000	0.0145	0.5167	-0.1252	51.7
Yam	0.2070	0.1722	0.1919	0.0497	0.4089	0.0145	1.0000	0.2853	0.2405	45.3
Plantain	0.6196	0.5373	0.2961	0.6501	0.4499	0.5167	0.2853	1.0000	0.5902	69.2
Cocoa	0.4876	0.4890	0.0664	0.2656	0.4465	-0.1252	0.2405	-0.5902	1.0000	51.8
Excluding 1983										
Maize	1.0000	0.6059	0.6750	0.8030	0.7841	0.5053	0.2022	0.6323	0.4506	40.2
Rice	0.6059	1.0000	0.4962	0.5805	0.4120	0.2241	0.1693	0.5384	0.4967	38.3
Millet	0.6750	0.4962	1.0000	0.8051	0.4557	0.4109	0.2170	0.3140	0.2071	36.7
Sorghum	0.8030	0.5805	0.8051	1.0000	0.5253	0.6080	0.0608	0.6672	0.3814	38.5
Cassava	0.7841	0.4120	0.4557	0.5253	1.0000	0.2783	0.4074	0.4549	0.4207	35.8
Cocoyam	0.5053	0.2241	0.4191	0.6080	0.2783	1.0000	0.0514	0.6473	0.1291	51.7
Yam	0.2022	0.1693	0.2170	0.0608	0.4074	0.0514	1.0000	0.2852	0.2412	44.4
Plantain	0.6323	0.5384	0.3140	0.6672	0.4549	0.6473	0.2852	1.0000	0.6333	70.1
Cocoa	0.4506	0.4967	0.2071	0.3814	0.4207	0.1291	0.2412	0.6333	1.0000	48.0

Source: Calculated from PPMED production data.

shortfalls in all crops during 1983, if that year is excluded, the variance of production in quantity terms is reduced.

The variances in value are larger as a percent of the mean (as indicated in the coefficients of variation) than are the variances in quantities. This is a bit surprising but can be explained with some further consideration. An inelastic price response could lead to severe swings in value.[13] Available data and analysis, however, do not indicate price elasticities in the range that would be fully in accord with this supposition. Moreover, the price that is used for this exercise is the December-January price, which is taken as an estimate of harvest prices. If, as is plausible, the quantity marketed in that period increases or decreases more than proportionally with the quantity produced, postharvest price swings might be exaggerated. This might occur, for example, if the amount that households bring to market is elastic with respect to quantity produced. Also, farmers may change their *timing* of sales in response to expectations, themselves based in part on harvest quantities. For example, farmers may sell a greater percentage of their total expected sales in the early part of the season, if the harvest is good and they do not expect a large seasonal price rise, and conversely in poor seasons. There is not enough known about price expectations in African markets, however, to either support or refute this logical possibility.

Note, furthermore, that for a few commodities, the variation of the value of production is actually slightly *more* when 1983 is removed. While this is unexpected, it is not unbelievable; severe shortfalls in 1983 were apparently accompanied by major price increases.

One can extend this discussion from the rather academic concept of the variance of production around a trend to a more practical consideration, namely that of the probability of a production shortfall, by noting that the probability of a shortfall around a linear trend, say 10 percent for discussion, can be computed as follows:[14]

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13 Suppose the demand is $\ln Q = a + \beta \ln P$, where Q and P are quantity demanded and price, respectively. The price elasticity is β, which is also $cov(\ln Q, \ln P)/var(\ln P)$; recognizing that the logarithm of total value of output is $\ln V = \ln P + \ln Q$, and $var(\ln V) = var(\ln P) + var(\ln Q) + 2\,cov(\ln P, \ln Q)$, one can solve for the values at β at which the variance of $\ln V$ exceeds $\ln(Q)$. In the short run, with Q predetermined, if the absolute value of the price elasticity is less than 0.5, the value of production would change more in percentage terms than the quantity of output. This model is, of course, only heuristic as it does not take into account cross-price effects and assumes that the demand curve is not stochastic. It does, however, illustrate that the possibility exists for the variance of value to exceed that of quantity.

14 See Andersen and Hazell (1989), for more details.

$$\text{Prob}\left(\bar{Q} + e_t \leq 0.95\ \bar{Q}\right) = \text{Prob}\left[\frac{e_t}{\sigma_t} \leq -0.10\ \frac{\bar{Q}}{\sigma_t}\right]$$

where $\bar{Q}$ is the average value of production, e_t the residual, and σ the standard deviation of e_t. One can get this probability from a table of standard normal deviates. These calculations are presented in Tables 10 and 11.

The table also includes an estimate of the probability that the value of representative production patterns will fall 10 percent or more from trend. In the absence of regional production information, this is estimated by assuming that the share of national production attributed to each of the three main agroecological zones is constant. Leaving this scaler as an unknown, one then constructs a weighted production index using constant weights in proportion to the share of production in each zone, the latter derived from the 1987-1988 GLSS. This is then detrended and the variability estimated as described above. This is only a rough proxy for the variability of income, food security, or any other real resource measure. Not only are regional variances not known, the index does not include a number of income sources, such as cash crops as well as nonagricultural incomes, as neither the magnitudes nor signs of their covariances with other income sources are known. Unless the other income sources are perfectly correlated with crop income, household incomes will vary less than agricultural income alone.[15] Moreover, resource control need not vary in a manner similar to incomes if savings, credit, or village support networks serve to stabilize consumption.

The table confirms that incomes in the savannah zone are more variable than in the other zones, although the difference is small. The basic conclusion that income variability is large and a greater concern for food security than price variability, nevertheless, is a concern for all zones.

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[15] Using data that indicate production variability similar to that observed here, Reardon, Matlon, and Delgado (1988) observe that the coefficient of variation of incomes in three zones in Burkina Faso is roughly two-thirds the magnitude of the coefficient of variation of crop earnings alone.

Table 10 — Ghana: Probabilities of Overall Weighted Production Shortfall, by Region

Region	10% Fall in Value	25% Fall in Value
Savannah	37.0	20.5
Forest	34.7	16.6
Coast	35.6	17.9

Source: Computed from PPMED production data, 1970-1990.

Table 11 — Ghana: Probabilities of Production Shortfall, by Crop

Crop	10% Fall in Quantity	10% Fall in Value
Maize	30.5	37.4
Rice	33.0	38.4
Millet	25.0	36.7
Sorghum	24.0	33.6
Cassava	33.3	34.9
Cocoyam	31.9	39.0
Yam	30.4	40.6
Plantain	32.5	42.2
Cocoa	25.4	32.3

Source: Computed from PPMED production data, 1970-1990.

3. MARKETING STRATEGIES

HOUSEHOLD STORAGE AND DISTRESS SALES

The timing of a household's sales, as well as the amount of marketed surplus, is an important determinant of food security. Clearly, whether a household is a net seller or net purchaser will determine whether the household benefits in the short run from a change in the terms of trade for a given commodity. The long-run impact will depend as well on the price response of the household.

The seasonal pattern of prices presents a different set of issues than does the average price level in any given year. The impact of intrayear price movements depends also on the timing of sales by each household and, therefore, on its ability to store. Often it is argued that the poorest households sell shortly after a harvest, in part to repay debts. If so, these households receive the lowest possible price for their produce. Implicit in this argument are the assumptions that the seasonal rise in prices exceeds the opportunity cost of capital (implying that the household loses from these early sales) and that a household cannot obtain or extend its credit between the harvest and the postharvest period. Few data on the timing and implicit costs of sales exist for developing countries, with the possible exception of South Asia.

As is indicated in Table 12, households in the Cornell-Fudtech survey did not report such a peak of sales in the immediate postharvest month. Indeed, in value terms, more sales from the 1989 harvest were reported in April-June 1990 than in November-January. To be sure, a portion of the rise in the value of April sales was due to the increase in food prices that occurred at that time. This rise was higher than the average rise in the past 15 years. This merely reinforces the view that a number of rural households are in a position to profit from the increase in the value of their inventory. Note that estimates of household incomes, which value production at harvest farmgate prices, will undervalue earnings attributable to household storage strategies.[16]

In quantity terms, the largest sales of maize appear to be in February and March. The average of the 320 households that planted maize sold 105 (18.35) kilos in October and November combined (standard error of the mean in

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[16] A recent analysis of storage and marketed surplus in India finds that the wealth effects of a seasonal price rise can increase consumption rather than sales (Renkow 1990). This is not necessarily the case for Ghana, although a time series similar to that used by Renkow is not available to test his model in Ghana.

Table 12 — Ghana: Monthly Agricultural Sales, 1989-1990

	Total Sales Revenue per Household	Percentage of Total Reported Sales Recorded by Month[b]					
		Maize	Rice	Yams	Beans	Groundnuts	Cocoa
	(Cedis)						
July 1989	2,226	0.2	3.1	0.2	7.6	18.6	—
August	7,050	3.0	0.0	16.9	6.1	3.9	4.1
September	9,220	9.5	0.1	4.5	6.6	8.6	23.7
October	11,187	8.6	2.7	8.8	2.0	8.7	11.6
November	9,294	7.2	12.6	3.3	4.9	7.2	18.5
December	17,152	16.7	6.7	11.4	11.8	6.1	31.3
January 1990	9,719	7.2	8.0	4.2	11.9	4.5	10.6
February	10,183	15.7	8.1	14.2	7.5	11.4	0.4
March	9,687	14.2	23.3	10.5	8.7	17.6	—
April	21,307[a]	9.0	22.4	13.3	15.0	12.0	—
May	14,190[a]	8.0	12.2	4.8	3.0	7.3	—
June	15,120[a]	0.4	0.6	7.7	14.7	8.8	—

Source: Cornell-Fudtech 1990 survey; N = 598.

[a] Households interviewed in April and May are excluded from June (May) averages.

[b] Total sales in quantity terms. Columns sum to 100 except due to rounding errors. Columns do not adjust for interview date and, therefore, underestimate April, May, and June percentages.

parentheses), 163 (24.35) in December and January, and 201 (30.2) in February and March. The February and March sales are significantly greater than the October and November sales (T=2.6), but not larger than the December and January sales. The sales in April and May appear to be as large as or larger than those in the previous two months. Even though the sample is smaller (due to the timing of the interviews), these sales also exceed those of October and November, and are marginally greater than those of December and January (T=1.87). In a similar vein, rice sales were observed to peak in March and April, and yams, with a relatively late harvest in Brong-Ahafo, to have a secondary peak at that time as well. Only for cocoa is there a pronounced peak immediately after the harvest. This, of course, is in keeping with the absence of a private trade in cocoa and therefore of incentives for private storage. While these peaks appear somewhat at odds with the conventional view that most sales occur immediately after harvest, the pattern is very close to those plotted from weekly observations in Atebubu district in Brong-Ahafo in 1976-1977 (Southworth, Jones, and Pearson 1979).

Additional supportive evidence is found in Ellsworth and Shapiro (1989), who studied marketing in Burkina Faso. They found that in quantity terms, more sales are in the second quarter after harvest (four to six months after the main harvest). Even in the third quarter after the harvest, sales were 62.5 percent of immediate postharvest sales in quantity terms, and likely very similar in value terms. They did observe that more households sold grain in the immediate harvest period — accounting for the popular perception of a sales peak at that time — but the largest sales were later in the crop year.

Table 13 takes this investigation further. Roughly a third of all producers of the main crops grown had stocks on hand in May 1990.[17] About 10 percent of these producers were estimated as having stocks sufficient to last them to the next harvest. This was calculated as the net amount left from the total harvest, subtracting sales, rent, gifts, seed, reported consumption, and an assumed rate of consumption until December that is equal to the rate reported since harvest. If, as is likely, the rate changes as stocks decline, these assumptions lead to an underestimate of the number of households with stocks sufficient for the crop year. Moreover, the December cutoff is very conservative. With the exception of yams, 90 percent of the 1989 harvest of major seasonal crops was completed by December.

Under the conservative assumptions above, there was a modest amount of food stored on farms available for sale in the lean season — estimated as the difference between stocks at the date of interview and the estimated amount of home consumption until December, at reported household levels of utilization. Although few households were likely to have sales during this period, the households with the largest surpluses store a fair portion of their harvest until later in the cropping year.

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[17] It is difficult to observe the seasonal pattern of plantains or cassava in a recall survey, as the household has no harvest date as an easy reference point. Indeed, it is relatively hard to record total production for these crops.

Table 13 — Ghana: Marketing Patterns, Brong-Ahafo and Upper East Regions, 1989-1990

	Maize	Rice	Millet	Sorghum	Yams	Cowpeas	Cassava	Groundnuts
Number of households planting	337	185	293	291	219	205	246	286
Number of households harvesting	302	167	278	273	208	188	246	276
Number of households selling at least once	224	99	17	39	99	53	34	152
Number of households selling more than once	94	31	2	7	59	9	18	34
Number of households selling more than two times	34	6	0	1	20	2	3	1
Households with commodity in storage as of May 1990	108	65	104	171	79	34	—	121
Households with storage estimated to exceed consumption until December 1991	29 (39)	14 (19)	18 (34)	32 (32)	9 (32)	12 (9)	—	37 (46)
Potential remaining sales as a percentage of total sales in sample	4.1 (4.8)	9.5 (10.2)	25.4 (77.7)	27.9 (27.9)	15.3 (15.3)	7.6 (7.6)	—	15.6 (18.2)
Number of households which carried stock from 1988 harvest past 1989 harvest	28	25	36	52	8	7	—	29

Source: Cornell-Fudtech 1990 survey; N = 598.

Note: Missing values counted as not harvesting. Values in parentheses pertain to cutoff at mode of harvest month rather than at December.

As is indicated in Table 14, the majority of this storage is held in simple structures; half of reported capacity is in rooms or sheds, another quarter in barns. Less than 5 percent is stored in improved sheds or silos. While these conditions are often taken as an indication that the government should be directly involved in storage, there is no indication that this storage fails to serve the existing market. As discussed elsewhere (Alderman and Shively 1991), the Cornell-Fudtech study, as well as other farm household surveys, indicates that farmers in Ghana do not report excessive post harvest losses. This survey indicates that households reported storage losses of only 2 percent of total *production*, on average. Losses, as a percent of production, were higher for maize (6 percent) and beans (4.5 percent) than for millet and sorghum (1 percent each). Losses were also higher in Brong-Ahafo than in the Upper East.[18]

Since a household does not retain all the harvest, one could also report these losses as a percent of the amount not marketed. Given the low marketed surplus for millet and sorghum, this calculation has little effect on the percentage of grain lost for those commodities. Given that nearly two-thirds of all maize in this sample was marketed, however, household losses as a percent of *retained* maize are closer to 18 percent. The conventional overestimate of storage losses is only moderate for maize, but particularly large for sorghum and millet.

Moreover, the damaged grain is not without value; 50 percent of the farmers with damaged maize report feeding the grain to their animals. A quarter of the grain is sold, although often at a discount and, again, often for use as feed. The rest is considered unfit for any use or else physically disappears.[19]

It is useful to consider what are the private incentives to storage at the farm level. To do this, one needs to consider the expected rise in price over the season. The regressions reported in Table 15 indicate the reported sales price from the sample as a function of the month and the location of the sale. It is noteworthy that the few households that sold grain to the government did not report a price different than that of other sales. For farm households that sold their grain directly to consumers, the markup for retail prices in per-kilo terms was far in excess of that reported in PPMED price series.[20] The main concern here, however, is with the monthly price increase. The increase of maize

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[18] Two studies cited by Jones (1972) and one by Hays and McCoy (1978) put losses of maize in Nigeria at as little as 5 percent in the savannah zone of Nigeria and even less for rice. At the very least, such studies indicate the range of estimates of on-farm losses and justify call for a more skeptical attitude for the prevailing assumption that Ghana's storage losses are 30 percent. This view is also expressed in FAO (1989).

[19] It is unlikely that farmers consider weight loss due to drying when responding to questions on storage loss.

[20] Reflecting, no doubt, that much of the margin is hidden in the packing of village weight bags, often 10-20 percent over the official weight.

Table 14 — Ghana: Storage Capacity

Type	**Percentage of Total Capacity**	**Average Capacity per Farm Household Using Storage in Kilos (number in parentheses)**[a]
Barn	24.3	2,429 (297)
Crib	13.5	2,996 (134)
Improved crib	0.6	2,062 (9)
Silo	3.3	1,476 (66)
Improved silo	0.1	4,000 (1)
Shed or room	49.3	4,097 (357)
Other	8.8	2,515 (104)

Source: Cornell-Fudtech 1990 survey; N = 598.

[a] Some farm households use more than one type of storage.

Table 15 — Ghana: Regression of Producer Price on Time (Dependent Variable is Logarithm of Reported Sales Price)

	Maize	Rice	Sorghum	Millet	Yams	Cassava	Cowpeas	Groundnuts
Constant	2.524 (0.146)	3.614 (0.161)	4.027 (0.368)	3.619 (0.996)	2.901 (0.282)	1.794 (0.595)	3.714 (0.488)	3.483 (0.192)
Month	0.095 (0.0007)	0.028 (0.012)	0.013 (0.023)	0.028 (0.104)	0.072 (0.020)	0.091 (0.042)	0.047 (0.029)	0.012 (0.013)
Region is Brong-Ahafo	0.043 (0.116)	0.049 (0.057)	0.261 (0.0167)	—	—	—	0.387 (1.57)	0.141 (0.081)
Buyer is government	0.024 (0.084)	—	—	—	—	—	—	—
Retail sales	0.263 (0.146)	0.637 (0.072)	0.289 (0.153)	0.578 (0.461)	—	—	0.598 (0.247)	0.616 (0.116)
Sale is within village	-0.043 (0.036)	-0.055 (0.048)	-0.318 (0.142)	-0.333 (0.316)	0.109 (0.074)	-0.535 (0.153)	-0.033 (0.161)	-0.072 (0.065)
R^2	0.37	0.39	0.22	0.19	0.13	0.25	0.12	0.16
N	341	131	40	19	138	53	60	167

Source: Cornell-Fudtech 1990 survey.

Note: Standard errors are reported in parentheses.

prices received by farmers surveyed exceeded the increase of most other crops during 1989/90. The monthly increase in the producer price of rice and millet was around 3 percent, although the latter was not significant given the very few price observations available. It was 1 percent (and not significant) for sorghum. The increase in the price of yams and cassava was closer to that of maize than to that of other grains.

The statistically significant, 9-percent-a-month average increase in nominal producer prices for maize is actually less than the average increase between the December and June wholesale price in Techiman for 1981-1990 as reported in PPMED data, excluding the 1983 famine price rise.[21] The average monthly December-to-June price increase in the 1980s was 13.2 percent (with a standard deviation of 9.1 percent). In real terms, the average rise was 8.3 percent. There are few, if any, investments available to farm households that would give this expected return. The average monthly price rise based on a much larger set of markets is still 6.5 percent (Alderman and Shively 1991).

While it is possible that increases in wholesale prices are not fully transmitted to farmgate prices, there is no evidence in the survey that would support this hypothesis. For example, the ratio of the price received, as reported by farmers selling maize in bags in Brong-Ahafo during May 1990, was 88.4 percent of the PPMED wholesale price for Techiman in that month. The December and January average prices reported by farmers were both within 3 percent of the price reported for the Techiman market. The standard errors of the mean price for both these months is small, less than one cedi per kilo. There is, nevertheless, a puzzle when comparing the prices from the two data sources. The price series move in parallel, as expected, but they are also closer to each other than any reasonable level of marketing costs would suggest.

This is not just an issue for Brong-Ahafo. Paddy prices for rice in the Upper East not only moved in tandem with PPMED prices for Bolgatanga, they ranged around 35 to 37 percent of the price of rice in the first six months of 1990. In keeping with the 50 percent milling ratio commonly reported, this implies a farmgate price in rice equivalents of 70 to 75 percent of the wholesale price. While sorghum sales are too infrequent to have a precise estimate of monthly producer prices from this survey, these prices appear to be in the neighborhood of 85 percent of the Bolgatanga wholesale price.

A plausible explanation for the closeness of the wholesale and producer prices may revolve around differences between "bush weight" and the subsequent volume of a bag in the wholesale market. While this cannot be investigated with the data on hand, the evidence implies that the movement of prices in the wholesale market appears to be transmitted to the producers — that is, the

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21 It is somewhat extraordinary that for the famine year, the price increase began by April — that is, by the time of the earliest possible indications of the failed rains. The rise, then, reflects information conveyed by the previous harvest, as well as the Harmattan weather patterns. Clearly, there are grounds for more research on the formation of price expectations in Ghana.

parallel movement in the price data implies that farmers can expect the same average rates of return for storage that wholesalers can expect.

Note, however, that the large standard deviation of seasonal price rises for maize in the Techiman market implies that a farmer's expected return to storage comes with appreciable risk as well. Indeed, the June 1989 price in Techiman was actually was less than the December 1988 price, in nominal terms, and the 1984 price rise was only 1 percent per month. Moreover, prices in the later part of the marketing season are more variable than in the postharvest months. For example, the coefficients of variation for the Techiman maize price for the months of November to June were 33, 35, and 28, respectively, while those for April to June were 64, 48, and 45. This is, of course, a limited sample, but there is no indication that the patterns differ in other major markets. Note that the price variability, even for the months of lowest price variation, indicates the difficulty of talking about a normal marketing year; the ratio of the highest to lowest December real price for maize in the 1980s was 4.1 to 1; the ratio of the mean price to the lowest price was 2.6 to 1. This reinforces the view presented earlier that price variability accounts for a fair portion of income variability of farmers.

The patterns and timings of sales discussed above mask a very important fact: 90 percent of the value of all sales reported in the two regions were made by farmers in Brong-Ahafo.[22] This reflects, among other things, the relative poverty of the Upper East region and its comparatively low production levels, as well as the fact that millet and sorghum are marketed far less than yams and maize. This, however, does not change the conclusion that farm households play a major role in the storage of marketed foods; the timing of sales in the two regions does not show a noticeably different pattern. The sales that do occur in the Upper East are distributed over the first six months or more of the calendar year. Similarly, there is no clear difference in the timing of sales by income group in this sample; the ratio of the amount of sales between February and April to those between November and January did not differ across income quantities in a region.

CREDIT UTILIZATION

Expansion of formal-sector credit in rural areas is often a component of agricultural policy, under the assumption (often unverified) that such an expansion will raise farm productivity. For the purposes of this study of food security, it is not necessary to restrict the discussion to the formal sector, especially as it remains, to a large degree, only a potential. As is indicated in other West African settings, informal-sector credit is widely available at the

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22 Although the survey ran more or less concurrently in both regions, the field work in the Upper East began two weeks prior to that in Brong-Ahafo. That slight delay could account for a minor bias in the relative magnitude of sales, but clearly not enough to account for the regional patterns.

village level. This credit is generally between individuals from the same village, often relatives (Udry 1990).

Two points are noteworthy. First, there is little evidence that this credit is either so burdensome or repayment so urgent as to require widespread distress sales.[23] Second, intravillage credit has a potential to buffer households facing short-term income shocks or special requirements due to illness or ceremonies. If, however, the shocks are positively covariant — that is, if the potential creditors and debtors experience income shocks at the same time — this potential may be reduced.

Table 16 reports the utilization of credit by the survey households during the prior year. Roughly a quarter of the sample obtained credit. This is likely an underestimate, if shopkeeper loans (short-term consumption loans) are available, as the survey did not ask about these explicitly.[24] Sixty-five percent of these loans were from neighbors (59 percent in value terms). The majority of these loans were interest free. Nearly 40 percent of the village loans were not paid in full by the time of the survey — that is, four to six months after all crops from the 1989 crop year were already harvested, many households had not yet paid their creditors. It is fair to presume, in the absence of other strong evidence either way, that the intravillage loan system does not make necessary immediate postharvest sales of grain at disadvantaged terms.

Other sources of credit do require interest payments, which are often substantial, although even for these sources a number of loans are interest free. The sample of such loans, however, is too small to state with any confidence what are the terms of borrowing.

As is indicated in Table 6 (bottom), within a region, there is little difference in the rate of credit utilization by expenditure group. Roughly the same number of people in each quartile obtain credit, although the amount they borrow increases with wealth. This pattern is consistent with a coinsurance interpretation of rural credit; credit flows between rural households frequently are reciprocal arrangements between neighbors, rather than one-way lending from a creditor to a debtor class. This view is also supported by another subsection of the survey, in which households were asked how they paid for major expenses in four categories — ceremonies (including funerals and marriages), medical expenses, purchases of durables, and construction. Often households commented

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23 Asante, Asuming-Brempong, and Bruce (1989) ask farmers for reasons for storage and for harvest sales. Very few reported demand by creditors influenced the time of sales. Conversely most indicate that they would strive to obtain a higher price.

24 Similarly, outstanding debts to, say, medical care providers, which were reported by the respondents, were not listed as loans (unless a third party advanced cash). From a macroeconomic perspective, however, such outstanding debt can be considered credit.

Table 16 — Ghana: Credit Utilization, by Source

Source	No. of Households Receiving Credit	Average Loan if Greater Than Zero	Average Amount Owed	Percent of Loans Paid in Full	Percent Cost Free if Paid in Full	Implicit Interest (on Loans Paid in Full) if Cost ≠ 0
						Percentage
Neighbor/friend	86	26,853	13,900	57.0	87.7	4.3
Government	21	35,217	1,857	80.9	41.2	27.1
Landlord	1	1,200	500	0.0	—	—
Grain traders	3	27,000	0	100.0	66.7	8.3
Other village sources	16	40,125	6,187	62.5	30.0	89.0
Other source outside village	5	24,270	14,190	40.0	50.0	50.0
All	**132**	**29,534**		**61.4**	**69.1**	**12.62**

Source: Cornell-Fudtech 1990 survey; N = 598.

that the loans they obtained were to meet the first two expenses. It is noteworthy that in 14.2 percent of all cases with reported expenditures in these categories, expenditures were financed out of sales of grain. This is in keeping with Southworth, Jones, and Pearson's (1979) observation that farmers primarily store to obtain seasonal profits, but that they also use grain as a means of meeting unanticipated obligations.

4. FOOD CONSUMPTION PATTERNS

RELATIONSHIP TO INCOME

The concentration on income as a determinant of household food security is based on the assumption that income levels and, perhaps, sources, are prime determinants of food consumption. While this appears intuitive, the strength of the relationship is under current debate.[25] Results from GLSS data show that the income elasticity for calories in Ghana is extremely high (Alderman and Higgins 1992). That is, as incomes increase Ghanaians appear to increase calorie consumption at a rate that is among the highest in a cross-country perspective. While such a relationship implies a significant impact of income-generation or transfer programs on the level of malnutrition in the country, the underlying commodity demand patterns that lead to the calorie relationship also imply strong upward pressure on prices if demand growth exceeds the increase in supply. These results appear in conflict with results derived from time-series estimates (see, for example, Asante, Asuming-Brempong, and Bruce 1989). Time-series estimates, however, generally differ from those obtained in cross-section studies. It is, nevertheless, useful to provide additional evidence on this question to narrow the range of uncertainty.

One methodological issue needs to be discussed at this time. Total expenditures are often used as a measure of long-run wealth or earnings, since they are less subject to transitory shocks and, often, less subject to systematic errors in reporting. Where food comprises a large portion of total expenditures, however, there is a likelihood that errors in measures of food consumption (or calories) will correlate with errors in the measure of long-run income. This can lead to an appreciable upward bias in estimated expenditure elasticities, as has been verified in number of empirical studies.

Given both the potential upward bias when using expenditures and the generally downward bias when using reported incomes (Alderman forthcoming), the approach followed here is to construct a measure of predicted (or permanent) income by regressing reported incomes on assets, including potential household labor and levels of education (see appendix for details). The dependent variable, the logarithm of calories available at the household level (purchase plus stock drawdown and in-kind transactions) was constructed from data on 38 commonly consumed foods. While there are various functional forms that can be used for such estimates, the basic results do not appear sensitive to alternative

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25 Some features of the controversy are discussed in Alderman and Higgins (1992). See also Alderman (forthcoming).

functional forms. The equation below indicates such a relationship (t-statistics in parenthesis):

$$\text{Ln Calories per Capita} = \underset{(1.37)}{-6.707} + \underset{(2.82)}{2.541}\ \text{Ln Income Per Capita} - \underset{(2.58)}{0.1092}$$

$$[\text{Ln Income Per Capita}]^2 - \underset{(2.26)}{0.1217}\ \text{Ln Household Size} -$$

$$\underset{(0.95)}{0.1458}\ \text{Percent Children} < 5 + \underset{(1.776)}{0.1435}\ \text{Brong-Ahafo}$$

$R^2 = 0.16$
N = 598

The results indicate that the income elasticity for calories is 0.24 at the sample mean income. The term for the square of income indicates that this elasticity declines significantly as incomes rise; it is 0.44 for households with incomes of 15,000 cedis per capita and 0.09 for households with 75,000 cedis per capita. These two cedi levels correspond to the average level of per capita income for the poorest quartile in the Upper East and the average per capita income for the third quartile in Brong-Ahafo, respectively (see Table 6). The positive dummy variable for region is significant at the 10 percent level for a two tailed test. While calorie consumption differs greatly in the two regions, this is apparently mainly due to the difference in incomes, although there are apparently some other systematic differences between regions.

Variables on household composition do not enter the regression significantly, although they do so when the model is expressed in terms of total incomes as opposed to per capita income. In alternative models, only one variable for the source of income proved significant; as the percent of income from agriculture increases, households apparently have *lower* calorie availability. (The coefficient is -0.15 with a t-statistic of 2.28.) The percent of total production that is sold does not seem to have a significant impact, nor does the area under cocoa. For various reasons, these are flawed measures of the degree of commercialization, but the absence of a clear relationship indicates that there is no reason to believe that farm households jeopardize household nutrition by relying on market transactions for the sale and, presumably, purchase of food. The negative correlation of agricultural incomes and food purchases or calorie availability may reflect the fact that the survey was conducted in the lean season, hence a time when cultivators may be more vulnerable than wage earners.

As mentioned, a number of measures were taken to reduce the chance of systematic bias due to correlations of errors. There is no component in the relatively complex calculations of the income variable that is also in the calculation of total expenditures. Even the prices used to impute income for producers who did not sell a crop came from the average farmgate price for the village, while the prices used to impute the value of home-consumed commodities for expenditures (in any case not used for calculating calories) came from the village average consumer price recorded in a different part of the questionnaire. There are, however, a large number of implausible levels of household calorie availability, as defined by purchases plus stock drawdown in the last week. Many households indicated that their calorie availability was less than 1,000 calories per capita per day or over 4,000. The wide dispersal reflects, in part, the difficulty of measuring commodities in home consumption, as well as the complexity of handling nonstandard units for market purchases. This reduces the precision of the estimates, as indicated, for example, in the t-statistics and r-square values. This does not, however, imply a biased coefficient, unless these errors are systematically correlated with incomes.

These results can be taken as evidence supporting the claim that calorie availability increases with income, especially at the lowest levels of income. This, then, reinforces the conclusion of Reutlinger and van Holst Pellekaan (1986) that income growth will, in the long run, eliminate much of household calorie deficits, and that income transfers or employment generation will alleviate the problem in the short run. This is an intuitively plausible view, although one under some criticism in recent years.

The greater controversy for Ghana, however, centers around the fact that calorie and commodity demand estimates seem to be higher, rather than lower, than experience based on other countries. Alderman (1990) and Alderman and Higgins (1992), for example, found that demand estimates based on the 1987-1988 round of GLSS data imply rapid increases in commodity demand with income growth. This holds despite a number of precautions taken to remove error correlations that may bias parameters upward. These income elasticities differ markedly from those reported by Asante, Asuming-Brempong, and Bruce (1989), in part because of the nature of time-series estimates referred to earlier. Barring an obvious methodological error, there is no objective way to reconcile two diverse sets of results from different data sets, even if they pertain to the same country. Additional data are generally required to narrow the range of uncertainty.

Although pertaining to two regions of the country only, the elasticities reported in Table 17 provide additional evidence on which to base expectations of income elasticities. These results are disaggregated, since there are clear regional patterns of consumption. While maize and rice are consumed in both regions, millet and sorghum are confined to the Upper East, and cassava, yams, cocoyams, and plantains are mainly consumed in the wetter zones. Consumption shares by agricultural zone for the entire country, based on GLSS data, are reported in Appendix Table 1, as well as in Alderman and Higgins (1992).

Before discussing Table 17, two qualifications should be discussed. First, elasticities estimated at sample means generally are not sensitive to alternative functional forms; those estimated from the Cornell-Fudtech data appear to be. The estimates reported here are from equations where the budget share is regressed on the logarithm of predicted income, with household size and the share of children in the household as additional regressors. If the logarithm of quantity is the dependent variable instead, the income elasticity of maize for

Table 17 — Ghana: Estimates of Income and Price Elasticities from Two Ghanaian Data Sets

Commodity	Cornell-Fudtech				GLSS[a]	
	Upper East		Brong-Ahafo		Country	
	Income	Own Price	Income	Own Price	Income	Own Price
Maize	1.22	-0.87	0.24	-0.43	0.18	-1.53
Rice	1.26	-1.43	1.30	-1.62	1.03	0.86
Sorghum	0.61	-0.75	—	—	—	—
Millet	0.36	n.e.[b]	—	—	—	—
Sorghum and millet combined	0.73	-0.76	—	—	-0.19	-0.53
Cassava	—	—	0.76	-0.37	0.70	-1.71
Yams	—	—	0.17	n.e.[b]	0.88	-0.97

[a] More details are presented in Alderman and Higgins (1992).

[b] Not estimated, insufficient price variation.

Brong-Ahafo increases, and that of cassava decreases.[26] Second, while income elasticities are generally estimated from cross-sectional data and considered as long-run adjustment, price elasticities are usually estimated from time series. When they are estimated from a cross-sectional data set, they generally are considered long-run adjustment to prices reflected in ecological and structural differences in the environment. As such, these elasticities are often larger in absolute value than any short-run adjustment to price fluctuations.

This considered, Table 17 can be viewed as confirming a moderate, but clearly positive, income elasticity for maize. This response is large in the Upper East, but its contribution to a national aggregate response would be low due to the comparatively small level of current consumption there. Rice, currently a minor contribution to the national diet, appears to serve the role of a luxury good, both in the regional estimates and nationwide. Luxury goods are, of course, not very important for food policy, but the high aggregate response indicates either future pressure on imports or a growing domestic market, depending on comparative costs of production and policy choices concerning crop protection. Millet and sorghum are not inferior goods in the Upper East, where they predominate in the diet, although they are in the savannah, as defined in the GLSS. Finally, there appears to be a moderately high-income elasticity for cassava (and cassava products) both in the Brong-Ahafo estimates and the GLSS results. This is a key parameter for agricultural policy. Given the reported sensitivity of this estimate to functional form, as well as the general difficulty in estimating home consumption with a crop which is measured in terms of roots that vary in size, less certainty can be placed on this estimate without yet additional information. Note, however, that Strauss (1982) found similar, high-income elasticities for cassava in Sierra Leone.

The share of food energy provided by different sources is reported in Table 18, disaggregated by expenditure groups as well as region. Although price or income elasticities indicate the percentage change in consumption of various commodities with a change in policy, the magnitude of the base level is also important for determining policy impacts. Although rice consumption increases with income, and further can be shown to be very price responsive, its share of total consumption makes it relatively unimportant for food policy.[27] Similarly, the share of wheat in the diets of households outside the coastal, urban zone is around 1 percent. On the other hand, millet and sorghum, which provide less than 1 percent of the food energy of the forest and coastal zones, as indicated in the GLSS (Appendix Table 1), provide anywhere from 47 to 71 percent of the calories in the Upper East, depending on income level. From the GLSS data, the share of millet and sorghum to total calories can be calculated as 34 percent for the savannah zone as a whole. Any food policy which ignores these foods is handicapped in the northern regions, which are also the regions with higher

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[26] For both these commodities the number of nonpurchasing households is inconsequential; entry into the market cannot account for this difference.

[27] This pertains to the perspective of consumers. Rice prices, of course, also affect producer incomes.

Table 18 — Ghana: Calorie Shares by Expenditure Quartile

Crops	Upper East 1	Upper East 2	Upper East 3	Upper East 4	Brong-Ahafo 1	Brong-Ahafo 2	Brong-Ahafo 3	Brong-Ahafo 4
Maize[a]	6.3	18.5	15.5	17.9	19.2	21.8	26.2	22.0
Millet	33.7	34.1	21.9	28.5	0.3	0.1	0.0	0.0
Sorghum	37.6	21.6	30.4	18.4	1.2	1.1	0.2	0.5
Rice	2.9	3.9	5.7	6.5	2.3	3.8	3.5	5.7
Yams	1.2	0.4	2.7	2.3	7.0	7.0	7.2	9.3
Cassava[b]	3.6	2.2	2.9	2.5	32.7	28.0	26.2	24.6
Cocoyam	0.0	0.0	0.0	0.0	10.0	8.6	7.6	8.7
Groundnut	6.2	10.1	11.1	10.8	2.4	3.4	2.9	3.2
Cowpea/bambara nuts	0.2	0.5	0.2	2.0	0.4	1.5	0.6	1.0
Fish	1.8	0.9	1.8	3.0	3.6	3.3	2.5	3.0
Meat	2.8	1.7	0.7	1.2	1.5	1.4	1.4	1.8
Oil/shea butter	2.1	2.7	2.1	3.1	5.8	5.0	6.3	4.9
Other	0.7	3.4	4.9	3.8	3.8	4.5	5.2	5.7
Plantain	0.0	0.0	0.0	0.0	9.8	10.5	10.2	9.6
Number of observations	75	75	75	75	74	75	75	74

Source: Cornell-Fudtech 1990 survey.

[a] Includes kenkey and banku.

[b] Includes gari, cassava flour, and dried cassava.

with higher levels of malnutrition. In contrast, root crops and plantains, particularly cassava, dominate the diets in the forest zone. Only maize is important in the diets of households in both regions.

RELIANCE ON MARKETS

As mentioned above, a number of recent studies indicate that rural households rely on nonfarm activities for an appreciable share of their incomes. They also obtain a fair share of their food by purchase rather than production. Appendix Tables 2 and 3, based on 1987-1988 GLSS data, indicate that this is particularly true for the coastal zone. Conversely, a moderately large share of the diet of urban households in the forest and savannah zones is obtained from home production. The share of home production from the Cornell-Fudtech survey is often lower than that reported in the GLSS data. For example, only 10 percent of maize for the poorest half of the population in the Upper East was obtained from home production, while 60 percent of millet was home produced. On the other hand, 86 percent of maize consumed by the poorest households in Brong-Ahafo was home produced. As with a number of other aspects of the data, differences between regions are greater than across income groups within a region. Recall, moreover, that the Cornell-Fudtech survey was undertaken between April and June, that is, in the period of highest reliance on the market.

Tables 19 through 21 explore the seasonality of patterns of market utilization, as defined by the percentage of households purchasing various foods in the previous two weeks during the 1987-1988 GLSS. Two different seasonal factors will determine any patterns in the probability of such purchases. First, one would expect that the reliance on the market, as opposed to home stocks, would increase with the months since the last harvest. On the other hand, as food prices rise in their annual cycle, households will shift among commodities.[28] Market purchases of maize, for example, are at their lowest point following the November/December harvest, as well as at the time of the early season harvest (Table 19). Gari purchases appear to increase in the months when grains are most expensive and decline in the immediate postharvest season. Yam purchases seems to decline after March, although here, as with most other commodities, the comparatively small size of the monthly cells make inference difficult. Noteworthy in Tables 19 and 20 also is the level of purchases; although comparatively few rural households buy maize grain in any given month, the majority buy some maize product, such as kenkey or banku. It is also significant that urban households are more likely to buy fresh cassava than any other food product, including maize, in any given two-week period (Table 20). Finally, one sees in Table 21 that the percent of urban households which produce a crop and also purchase it in any given month differs only slightly from the general pattern in rural areas.

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[28] Alderman and Higgins (1992) indicate that the price elasticities that can be estimated from such short-run shifts are plausible measures of consumer behavior.

Table 19 —Ghana: Percent of Rural Households Using the Market, by Month of Survey and Crop

Food	1987				1988								
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Cassava and cassava prod.	48.7	38.7	45.5	32.2	58.1	45.7	55.8	43.9	75.0	52.3	44.0	38.2	33.3
Raw	27.2	17.7	24.0	12.2	30.4	18.1	27.6	16.9	29.2	18.6	20.7	14.6	7.8
Gari, dough, tapioca, etc.	22.0	23.1	25.0	22.2	44.7	31.5	47.2	39.2	66.7	45.3	38.0	27.6	27.5
Fufu[a]	16.2	7.5	9.5	5.6	11.1	8.7	10.4	4.1	15.3	8.1	7.3	4.1	5.9
Yam	31.9	19.4	24.0	33.3	22.6	28.3	16.0	14.9	27.8	15.1	9.3	5.4	5.9
Cocoyam	9.4	2.7	7.5	8.9	16.6	10.2	15.3	6.1	14.6	5.8	6.0	4.9	2.0
Plantain	29.8	2.9	28.0	1.1	2.7	24.4	27.6	16.9	36.1	1.6	16.0	7.9	3.7
Maize and maize products	73.8	70.4	74.5	65.6	77.9	71.7	80.4	61.5	75.7	69.8	63.3	67.5	45.1
Cob, grain, dough, flour	16.8	14.5	9.5	5.6	18.4	12.6	22.1	13.5	33.3	36.0	17.3	9.8	5.9
Rice	46.6	46.2	49.0	38.9	53.5	37.8	46.6	41.2	48.6	37.2	38.0	30.1	21.6
Millet/sorghum	21.5	22.0	23.5	15.6	25.8	33.9	38.0	15.5	22.9	19.8	40.7	35.0	7.8
	(N=191)	(N=186)	(N=200)	(N=90)	(N=217)	(N=127)	(N=163)	(N=148)	(N=144)	(N=86)	(N=150)	(N=123)	(N=51)

Source: 1987-1988 GLSS.

[a] All fufu purchases are attributed to cassava for this table.

Note: Based on numbers of households reporting purchases in previous two weeks.

Table 20 —Ghana: Percent of Urban Households Using the Market, by Month of Survey and Crop

Food	1987				1988								
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Cassava and cassava prod.	93.3	88.9	76.8	90.5	67.4	79.9	84.8	90.6	87.6	86.7	96.1	91.0	77.1
Raw	70.0	61.1	54.9	83.3	46.3	52.7	57.0	59.0	71.9	67.8	68.8	61.8	52.1
Gari, dough, tapioca, etc.	73.3	66.7	55.6	73.8	37.9	59.8	63.3	74.4	62.9	63.3	79.2	61.8	66.7
Fufu	36.7	44.4	21.1	16.7	18.9	23.1	25.9	20.5	18.0	15.6	36.4	32.6	22.9
Yam	56.7	61.1	54.9	81.0	52.6	52.7	47.5	48.7	33.7	34.4	42.9	51.7	54.2
Cocoyam	16.7	22.2	21.1	33.3	17.9	27.8	27.8	31.6	33.7	22.2	26.0	15.7	20.8
Plantain	70.0	66.7	59.2	88.1	44.2	57.4	63.3	60.7	67.4	62.2	63.6	57.3	62.5
Maize and maize products	100.0	100.0	90.1	97.6	84.2	90.5	86.7	88.0	92.1	94.4	98.7	94.4	85.4
Cob, grain, dough, flour	43.3	77.8	44.4	40.5	31.6	40.8	43.7	43.6	44.9	46.7	54.5	57.3	43.8
Rice	73.3	88.9	65.5	83.3	75.8	68.6	60.1	76.1	64.0	75.6	77.9	67.4	54.2
Millet/sorghum	53.3	72.2	33.1	28.6	41.1	45.6	46.2	38.5	66.3	56.7	57.1	50.6	45.8
	(N=30)	(N=18)	(N=142)	(N=42)	(N=95)	(N=169)	(N=158)	(N=117)	(N=89)	(N=90)	(N=77)	(N=89)	(N=48)

Source: 1987-1988 GLSS.

Note: Based on numbers of households reporting purchases in previous two weeks.

Table 21 —Ghana: Percent of Producer Households Purchasing in the Market, by Month of Survey and Crop

Food	1987				1988								
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Cassava and cassava prod.	45.7	38.4	45.5	35.1	55.8	52.4	59.1	50.9	73.1	62.4	46.2	41.4	56.2
	(N=162)	(N=146)	(N=213)	(N=77)	(N=226)	(N=126)	(N=164)	(N=159)	(N=171)	(N=85)	(N=119)	(N=111)	(N=64)
Raw	21.6	15.8	20.7	19.5	27.9	19.0	26.8	21.4	33.3	27.1	25.2	18.0	23.4
Gari, dough, tapioca, etc.	22.8	23.3	30.0	20.8	38.5	38.9	49.4	43.4	63.7	51.8	40.3	27.0	39.1
Fufu	17.3	7.5	9.9	7.8	12.4	14.3	11.6	6.9	16.4	7.1	8.4	7.2	15.6
Yam	21.4	13.0	17.8	1.1	1.5	20.5	25.6	1.1	34.3	19.3	16.7	20.3	19.6
	(N=84)	(N=92)	(N=101)	(N=38)	(N=130)	(N=73)	(N=90)	(N=109)	(N=105)	(N=57)	(N=72)	(N=74)	(N=46)
Cocoyam	10.8	3.4	6.0	10.2	7.2	9.4	13.3	9.3	18.4	11.1	0.0	7.9	11.4
	(N=65)	(N=88)	(N=150)	(N=59)	(N=138)	(N=85)	(N=120)	(N=107)	(N=114)	(N=27)	(N=35)	(N=76)	(N=44)
Plantain	23.2	13.1	20.3	13.8	15.9	18.3	21.9	15.5	37.6	37.0	15.4	16.7	27.5
	(N=82)	(N=99)	(N=138)	(N=58)	(N=132)	(N=82)	(N=114)	(N=103)	(N=117)	(N=27)	(N=39)	(N=78)	(N=51)
Maize and maize products	72.3	67.9	78.0	72.4	75.6	74.5	85.9	67.1	78.1	69.8	72.0	65.3	61.6
	(N=159)	(N=159)	(N=205)	(N=76)	(N=221)	(N=153)	(N=149)	(N=161)	(N=160)	(N=96)	(N=125)	(N=118)	(N=73)
Cob, grain, dough, flour	17.0	11.9	14.1	3.9	12.2	18.3	22.8	17.4	35.0	26.0	18.4	12.7	19.2
Rice	27.8	20.0	22.7	31.3	22.2	36.4	25.9	5.9	33.3	14.3	46.2	28.6	8.3
	(N=18)	(N=20)	(N=22)	(N=16)	(N=27)	(N=22)	(N=27)	(N=34)	(N=6)	(N=7)	(N=26)	(N=7)	(N=12)
Millet/sorghum	11.5	2.6	3.0	26.7	18.8	27.3	56.0	0.0	0.0	9.1	48.8	14.3	0.0
	(N=26)	(N=38)	(N=33)	(N=15)	(N=48)	(N=33)	(N=25)	(N=31)	(N=0)	(N=33)	(N=43)	(N=21)	(N=12)

Source: 1987-1988 GLSS.

Note: Based on numbers of households producing a crop which also reported purchasing that crop in the previous two weeks.

The welfare impact of a price rise, however, depends not on the frequency or level of purchases, but on the net value of production minus purchases. Deaton (1988) both illustrates such a principle in the context of household utility theory and shows that whether poor households are more or less likely to benefit from a price change is an empirical question. A priori assumptions that the rural poor gain from price increases often prove invalid.

Explorations of sales and purchase patterns based on GLSS data (and therefore not disaggregated by region) indicate that the relationship of expenditure per capita and marketing patterns is not uniform across commodities. One of the more surprising results illustrated in Table 22 is the fact that the wealthiest households — defined in terms of income per capita — often produce less of many crops than do poorer households. As this relationship is based on a sample restricted to producers, it is not an artifact of the prevalence of urban households in the upper-income cells. There is, however, a negative relationship of expenditure per capita and household size, so the smaller levels of production in the wealthiest groups reflect smaller size. Given the limited amount of cultivation in Ghana by hired labor or with machines, these households cultivate comparatively smaller areas. There is a general tendency for these smaller households to market a larger proportion of their produce, but the relationship found using the GLSS data is by no means pronounced or even uniform.[29]

Table 23 indicates the net position (production net of consumption) for producing households in each expenditure quintile. As before, the GLSS data do not indicate a strong pattern across groups when households are ranked in terms of expenditure per capita. The table does indicate, however, that due to the nature of grain trade, most producer households in all expenditure groups benefit from a price increase for grains or yams; this is a pattern that is often not observed in land-scarce countries, where producers constrained by land scarcity often are net purchasers of grain. This again supports a theme of this study, that variation across regions in Ghana is comparatively large in relation to differences across income or expenditure groups within regions.

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29 A different pattern would be observed if the households were grouped by household rather than per capita expenditure or incomes, but the per capita formulation is likely a better indicator of relative welfare.

Table 22 — Ghana: Marketed Surplus and Production for Producers of Major Food Crops, by Expenditure Quintile and Agroecological Zone

	Coast			Forest			Savannah		
	Marketed Surplus		Production	Marketed Surplus		Production	Marketed Surplus		Production
	(%)	(N)	(kg)	(%)	(N)	(kg)	(%)	(N)	(kg)
Cassava									
1st	12.5	76	1,783	25.3	233	1,640	13.7	112	1,103
2nd	28.4	104	1,622	22.2	264	1,318	19.5	69	1,293
3rd	29.2	126	1.755	22.3	262	1,172	15.8	56	1,102
4th	19.9	109	1,574	26.6	207	1,008	32.9	27	814
5th	53.4	86	1,254	39.2	85	905	39.1	7	1,370
Yam									
1st	32.5	21	353	10.6	133	206	54.7	158	1,433
2nd	37.9	26	351	20.2	144	299	45.2	78	2,193
3rd	45.5	47	326	23.3	155	313	60.9	52	1,985
4th	17.7	27	500	51.1	135	429	81.1	21	3,753
5th	25.1	20	195	20.2	48	197	42.1	6	1,993
Cocoyam									
1st	23.6	22	438	31.0	190	619	28.0	17	408
2nd	24.5	32	422	15.8	220	490	24.6	27	609
3rd	20.0	42	474	29.0	215	542	26.9	18	298
4th	15.0	36	449	23.9	180	392	23.2	14	512
5th	48.8	26	360	19.0	68	311	—	1	—
Plantain									
1st	35.4	21	803	47.6	194	1,216	53.4	20	602
2nd	45.7	26	674	52.7	226	1,377	65.3	21	635
3rd	23.9	36	416	56.4	222	1,408	64.2	17	912
4th	26.1	37	486	69.8	186	1,014	43.9	13	1,010
5th	67.3	33	431	69.8	67	1,014	—	1	—

Table 22 (continued)

	Coast			Forest			Savannah		
	Marketed Surplus		Production	Marketed Surplus		Production	Marketed Surplus		Production
	(%)	(N)	(kg)	(%)	(N)	(kg)	(%)	(N)	(kg)
Maize									
1st	31.0	70	551	45.5	230	549	15.6	191	986
2nd	33.8	90	429	41.0	250	404	23.9	105	824
3rd	32.6	114	460	45.0	244	422	32.1	70	612
4th	35.6	92	361	46.5	199	402	47.4	30	642
5th	50.6	76	366	65.1	83	300	61.3	11	1,091
Millet/sorghum									
1st	—	—	—	—	—	—	8.8	208	1,123
2nd	—	—	—	—	—	—	6.3	86	773
3rd	—	—	—	—	—	—	13.6	39	524
4th	—	—	—	—	—	—	45.8	12	703
5th	—	—	—	—	—	—	48.7	7	992
Rice									
1st	55.6	4	288	19.1	18	201	66.4	97	505
2nd	—	1	436	38.3	19	445	77.1	32	1,098
3rd	76.9	8	715	55.1	16	284	54.8	20	445
4th	—	0	—	36.7	11	723	62.0	4	484
5th	84.9	4	2,946	22.8	7	250	66.7	3	1,350

Source: 1987-1988 GLSS.

Notes: Quintile rankings are based on predicted per capita household expenditures, calculated over the entire sample of households; cell sizes thus are variable accros cells. Means calculated using only households producing the crop that fall into the respective zone-quintile cells.

Table 23 —Ghana: Numbers of Producers with Positive, Negative Net Production, by Agroecological Zone and Expenditure Quintile

Quintile	Cassava		Yam		Cocoyam		Plantain		Maize		Millet/ Sorghum		Rice	
	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg
1st Quintile														
Coastal	47	44	11	12	11	16	15	9	57	29	0	0	4	1
Forest	148	83	7	62	105	85	136	56	170	56	1	1	9	8
Savannah	53	47	131	14	13	5	16	3	150	24	163	38	83	14
Pooled	248	174	212	88	129	106	67	68	377	109	164	39	96	23
2nd Quintile														
Coastal	43	53	11	18	11	13	15	9	47	33	0	0	5	1
Forest	162	103	88	58	120	104	157	76	192	65	1	0	16	4
Savannah	39	35	67	14	15	9	18	4	89	21	68	14	32	1
Pooled	244	191	166	90	146	126	190	89	328	119	69	14	53	6
3rd Quintile														
Coastal	60	54	18	19	15	19	22	8	69	37	0	0	2	0
Forest	146	104	91	56	111	98	141	77	180	55	0	2	15	3
Savannah	31	29	49	9	12	8	12	6	64	11	35	10	14	2
Pooled	237	187	158	84	138	125	175	91	313	103	35	12	31	5
4th Quintile														
Coastal	56	47	13	15	24	15	24	15	47	38	0	0	0	0
Forest	131	81	87	50	105	74	126	46	167	31	0	0	8	1
Savannah	16	12	23	1	12	1	10	1	30	5	14	4	7	1
Pooled	203	140	123	66	141	90	160	62	244	74	14	4	15	2
5th Quintile														
Coastal	43	53	10	14	17	17	16	20	52	35	1	0	3	1
Forest	40	53	21	32	36	35	43	37	62	28	0	0	5	2
Savannah	6	3	6	1	2	0	1	1	11	2	5	1	2	0
Pooled	89	109	37	47	55	52	60	58	125	65	6	1	10	3

Source: 1987-1988 GLSS.

Notes: Quintile ranks based on predicted per capita household expenditures, calculated over all households in the sample. Negative net production is defined as production net of consumption, in kilograms.

5. CONCLUSIONS

Research results fall in three broad categories: those that are dismissed because everyone already believed them to be true prior to the study, those that are dismissed because everyone believes them not to be true despite the evidence presented, and those that change what some people believe to be true. It is likely that this paper — and the companion studies in the food security project — contains results that fall in all three categories.

Among the results in the first category are the strong indicators of the regional pattern of poverty. Such results, however, are not without their value. They not only quantify the magnitude of income disparity — Table 6, for example, indicates that the poorest households in Brong-Ahafo would be among the wealthiest in the Upper East — but they also complement the crucial argument that food security revolves around income generation as much as it does in assuring that aggregate production meets aggregate demand. Moreover, the data indicate that even among the rural poor, nonagricultural activities provide a significant share of income and provide some diversification of risk. This also implies an entry point for food security measures, particularly in terms of employment generation schemes.

To a fair degree, Ghanaian consumers mitigate the consequences of price fluctuations with cross-commodity substitutions. This appears less the case for households in the savannah, who have less root crops in their diets. Nevertheless, low income appears to be the main constraint to calorie consumption. This is indicated by the pronounced increase of calories with increased income at lower levels of long-run income.

A food security component of any agricultural strategy needs to confront the fact that there are tradeoffs between such priorities and maximizing aggregate agricultural GNP growth; there is no assurance that the regions or crops with the highest potential for short-term economic growth will be the same as those that will reduce hunger by raising incomes of the poor. While clearly any strategy needs to balance both approaches, the mix of priorities will differ depending on the weights that planners place on such priorities. The mix, then, is not based purely on any set of research results, but also on the long-run welfare objectives of the country.

The results in this study (as well as parallel analysis of GLSS data), however, do help illustrate the nature of a household food security component of agricultural policy. They imply, for example, that a food security component should consider sorghum and millet as a greater priority than would be the case if the growth of agricultural GNP were the only consideration in sectoral planning. Not only are these crops the mainstay of diets in the regions of highest levels of malnutrition, but they are also the main sources of income in these regions. They contribute over half the calories in the Upper East, and nearly 35 percent of food energy in the entire savannah agroecological zone (Alderman and Higgins 1992). Rice, which, when aid and imports are included, makes roughly the same total contribution to the nation's food supply as either millet or sorghum alone, never contributes more than 5 percent of calories for any agroecological zone, urban or rural. Moreover, evidence in this report and elsewhere indicates that commodity is a luxury good.

This comment does not imply that rice is not important as a source of income even in food-deficit regions and among low-income households. The same evidence on income elasticities cited above also implies that per capita demand should grow at roughly the rate of the economy. Furthermore, by virtue of its availability on the international market and as a component of food aid, it is relatively easy for planners to influence domestic availability and price. This pertains, however, mainly to the rice market in the south of the country, a market which differs greatly from that in the north. A recognition of the distinction of these markets can help in the design of trade policies that support rural producers' incomes, perhaps by sanctioning trade to Burkina Faso and other neighboring countries, while at the same time meeting objectives for stable urban prices in the major population centers in the south.[30]

The results here also document the extent of on-farm storage. Although virtually all of it is in simple structures, there is clear evidence in this study, as well as others cited, that farmers distribute their sales through much of the year (Table 12). As such, they profit from seasonal price rises. As an order-of-magnitude estimate, if farmers in Brong-Ahafo sold their produce at postharvest prices, rather than at the mix of prices recorded in the survey, they would have received 31,000 cedis less per household. This is 8 percent of the total value of farm output, including retained production. The corresponding figure is 2 percent for the less-commercialized households in the Upper East.

This implies that any government storage which involves a subsidy on the real cost of storage will be transferring income from those farmers who store to those households (urban and rural) who use the market. The distributional issues are largely unknown, in part because they are generally not considered. Moreover, were the government to reduce the early-to-late, seasonal price differential, farmers would have less incentive to store on-farm. They would sell earlier, thus increasing the amount that needs to be stored off the farm. While the cross-sectional data here do not allow a measurement of the price response of storage, from the magnitude of farm sales four to eight months after

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30 Consider an analogous situation: In the name of "energy security" the United States Congress forbids the sale of Alaskan oil to Japan, although economists can demonstrate that the United States profits by making such sales and replacing them with imports from Mexico and elsewhere. This result comes from the fact that transport to the East coast consuming regions is more expensive in the case of Alaskan oil than for Mexican oil.

the harvest it would appear that even a small percentage shift will be large relative to current off-farm storage capacity.[31]

As an order-of-magnitude estimate, given that over half the maize produced in the country is marketed and that about a third of private sales are after February, a reduction of these late season sales by only 10 percent would mean an increase of sales in the immediate postharvest period of roughly 12,500 tons. This is 50 percent of the maximum government storage in any year prior to 1990. To be sure, government storage may increase, but the 10 percent response used for this illustration is an assumption that may be far less than observed behavior if incentives change markedly.

It should also be noted that this study finds no strong evidence of postharvest distress sales. While a number of households do sell grain to meet medical or other unexpected expenses, these are distributed throughout the year. Moreover, households are more likely to sell chickens or livestock to meet such expenses. Finally, the study documents that a moderately sized informal credit market exists. This market appears to serve as a means of insurance (at least for shocks that are not correlated across households, such as illnesses) and provides the bulk of reported credit for agricultural inputs as well. As has been observed elsewhere, there is a range of reported interest rates with a mode at zero. There is no evidence in these data that farmers are required to pay back loans at harvest time.

Although households appear to store grain across seasons, they do not report holding grain over between years. Approximately 10 percent of all producers reported holding stocks from 1988 up until the 1989 harvest with a similar, albeit rough, projection for the number of households likely to be in this position in 1990. This, then, suggests an alternative avenue or objective for national storage policy. It does not, of course, indicate that such a policy would have a net benefit — this is a subject currently under investigation at Cornell — but it does indicate that a potential niche exists.

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[31] Pinckney (1989) documents how costly a small percentage change in storage subsidies can be with a study from Pakistan. This is because total costs are the product of the quantity stored by the government times the unit subsidy. When the latter increases, so does the former as farmers increase their sales, unless quotas restrict the amount to be stored at a subsidy. Such quotas, however, not only have major distributional consequences, but they may also reduce or limit the benefits to consumers that come from any attempts at intraseasonal stabilization.

APPENDIX
EQUATION TO INSTRUMENT INCOMES

While the main objective for regressing income on assets is to construct a measure of long-run income for use in predicting calorie and commodity demand or for disaggregating tables by wealth, the instrumenting equation is itself of interest. A pooled variant of the estimating equation is presented below:

$$\begin{aligned}
\text{Income (in cedis)} = & - 44{,}113 + \underset{(9.05)}{8{,}857.5} \text{ cocoa area} + \underset{(5.47)}{19{,}696.6} \text{ irrigated area} \\
& + \underset{(0.25)}{65.54} \text{ fruit trees} + \underset{(3.37)}{44{,}940.4} \text{ adult male} + \underset{(2.33)}{29{,}018.7} \text{ adolescent males} \\
& + \underset{(0.04)}{516.5} \text{ adult females} - \underset{(1.43)}{17{,}138} \text{ adolescent females} - \underset{(5.37)}{1.58} \text{ value of tools} \\
& + \underset{(3.79)}{0.78} \text{ value of vehicles} + \underset{(6.34)}{1.56} \text{ value of storage structure} \\
& + \underset{(2.75)}{8{,}534} \text{ number of cattle} + \underset{(1.58)}{2{,}409} \text{ number of sheep and goats} \\
& - \underset{(1.58)}{24{,}614} \text{ no. of males with primary educ.} - \underset{(0.22)}{4{,}616} \text{ males with post primary} \\
& - \underset{(0.88)}{32{,}510} \text{ female with primary} + \underset{(1.78)}{40{,}908} \text{ female with post primary} \\
& + 294{,}199 \text{ Brong-Ahafo}
\end{aligned}$$

$R^2 = 0.53$
$N = 586$

The coefficients of the asset variables are plausible, although in a few cases higher than might be expected. Note that each additional cocoa acre, holding other assets and household labor force constant, raises income by nearly 9,000 cedis. The coefficient of irrigated land also indicates a sizable increment to household income from this investment. The household labor and education variables, however, are less plausible.[32] Note, however, that in the equation

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[32] This is in distinction to a similar exercise using the 3,000 households in the GLSS data. In those equations, education and age and gender variables were (continued...)

for Upper East alone, the coefficient of female primary education is positive and significant, and that of the number of women in the household is the same magnitude as the number of males, although imprecisely estimated. Finally, the equation indicates that the average income in Brong-Ahafo is higher than that in the Upper East by nearly 300,000 cedis, controlling for the level, but not quality, of assets. Total land cultivated is not included, as it is a function of total household labor. Total land owned is often not a useful concept, as many communities own land in common.

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[32](...continued)
the coefficients for variables for land cultivated, or even cocoa area, were small and often not significant.

Appendix Table 1 — Ghana: Calorie Share Means For Major Food Groups and Staples, by Agroecological Zone Under Smoothed GLSS Prices

Item	Rural			Urban			
	Coastal (n=514)	Forest (n=933)	Savannah (n=429)	Accra City (n=328)	Non-Accra Coast (n=341)	Forest (n=388)	Savannah (n=108)
Cereals	0.263	0.193	0.634	0.376	0.312	0.249	0.486
Maize	0.147	0.118	0.257	0.108	0.136	0.112	0.223
Millet/sorghum	0.001	0.001	0.336	0.002	0.001	0.000	0.172
Rice	0.016	0.022	0.024	0.063	0.042	0.034	0.043
Kenkey/banku/akpler/tuo zaafi	0.076	0.035	0.009	0.122	0.090	0.064	0.025
Roots/tubers	0.501	0.600	0.242	0.311	0.388	0.468	0.295
Cassava	0.323	0.337	0.102	0.107	0.183	0.213	0.114
Gari and other cassava prods.[a]	0.099	0.024	0.024	0.078	0.104	0.046	0.055
Yams[a]	0.016	0.034	0.087	0.042	0.025	0.044	0.092
Cocoyams	0.026	0.101	0.014	0.008	0.018	0.072	0.007
Plantain[a]	0.030	0.098	0.013	0.041	0.041	0.078	0.022
Meats/fish	0.082	0.072	0.036	0.113	0.097	0.095	0.047
Fish	0.077	0.063	0.029	0.099	0.091	0.082	0.032
Red meats	0.003	0.008	0.006	0.012	0.005	0.011	0.013
Poultry	0.002	0.002	0.001	0.003	0.001	0.001	0.002
Dairy products/eggs	0.001	0.001	.0003	0.003	0.002	0.002	0.001
Oils/fats	0.057	0.049	0.027	0.086	0.088	0.074	0.056
Other[b]	0.095	0.084	0.060	0.111	0.113	0.111	0.116
Mean daily per cap. calorie intake	2,905	2,670	2,992	3,019	2,645	2,375	2,751

Source: Ghana Living Standards Survey (1987-1988), reported in Alderman and Higgins (1992).

[a] Fufu expenditures were arbitrarily apportioned 50 percent to cassava, 25 percent each to yam and to plantain.

[b] Consists of calories represented by sugar and groundnuts only. Not comparable to "Other" category in expenditure shares.

Appendix Table 2 — Ghana: Share of Home Production in Rural Food Expenditure, Top and Bottom Quintiles, by Agroecological Zone

Commodity	Coastal		Forest		Savannah	
	Lower	Upper	Lower	Upper	Lower	Upper
Total food	0.266	0.281	0.486	0.415	0.663	0.650
Cereals	0.279	0.199	0.479	0.452	0.876	0.849
Maize/kenkey	0.356	0.303	0.615	0.658	0.906	0.887
Rice	0.000	0.048	0.126	0.129	0.521	0.570
Millet/sorghum	—	—	—	—	0.932	0.973
Roots/tubers	0.592	0.589	0.824	0.738	0.868	0.831
Cassava/gari/fufu	0.650	0.606	0.817	0.726	0.813	0.861
Yams	0.572	0.597	0.746	0.563	0.935	0.819
Sweet potato/potato	0.683	0.122	0.667	0.112	0.754	0.481
Cocoyam	0.808	0.775	0.944	0.927	0.977	0.884
Plantain	0.404	0.576	0.887	0.836	0.936	0.848
Meats/fish/dairy	0.059	0.129	0.066	0.119	0.218	0.345
Beef	0.000	0.055	0.000	0.000	0.000	0.000
Poultry	0.429	0.335	0.638	0.554	0.828	0.730
Other meats	0.474	0.296	0.284	0.334	0.498	0.262
Fish/shellfish	0.027	0.082	0.001	0.011	0.059	0.416
Milk/cheese	0.000	0.000	0.000	0.008	0.089	0.000
Other foods	0.227	0.241	0.412	0.414	0.430	0.579
Oilpalm oil/nuts	0.250	0.274	0.537	0.501	0.302	0.297
Other oils/fats	0.091	0.152	0.025	0.179	0.009	0.221
Groundnuts	0.000	0.110	0.196	0.161	0.639	0.927
Fruits	0.337	0.442	0.848	0.820	0.444	0.230
Vegetables	0.297	0.313	0.482	0.422	0.633	0.790
Alcoholic beverages	0.000	0.000	0.106	0.247	0.019	0.009
N	67	144	179	182	137	57

Source: GLSS, reported in Alderman (1990).

Notes: Calculations are ratios of consumption from home production to total consumption. These differ from self-sufficiency ratios, which are ratios of total production to total consumption. Ratios for millet/sorghum consumption are calculated only for the savannah zone, since only small amounts are consumed in the other regions of the country.

Appendix Table 3 — Ghana: Share of Home Production in Urban Food Expenditure, Upper and Lower Quintiles, by Agroecological Zone

Commodity	**Coastal**		**Forest**		**Savannah**	
	Lower	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**
Total food	0.067	0.039	0.252	0.097	0.454	0.105
Cereals	0.066	0.067	0.174	0.065	0.679	0.092
Maize/kenkey	0.103	0.142	0.269	0.142	0.707	0.131
Rice	0.001	0.000	0.021	0.000	0.204	0.090
Millet/sorghum	0.000	0.000	0.000	0.000	0.872	0.030
Roots/tubers	0.113	0.081	0.520	0.214	0.546	0.233
Cassava/gari/fufu	0.135	0.117	0.483	0.163	0.717	0.251
Yams	0.000	0.018	0.432	0.326	0.352	0.069
Sweet potato/potato	0.341	0.000	0.000	0.025	0.000	0.000
Cocoyam	0.407	0.196	0.827	0.575	0.951	0.195
Plantain	0.078	0.078	0.560	0.267	0.369	0.538
Meats/fish/dairy	0.042	0.028	0.047	0.062	0.188	0.006
Beef	0.000	0.000	0.000	0.000	0.321	0.000
Poultry	0.149	0.067	0.404	0.253	0.613	0.046
Other meats	0.000	0.043	0.134	0.177	0.313	0.014
Fish/shellfish	0.041	0.024	0.000	0.000	0.032	0.000
Milk/cheese	0.000	0.000	0.000	0.000	0.000	0.000
Other foods	0.020	0.029	0.144	0.088	0.307	0.101
Oilpalm oil/nuts	0.026	0.008	0.171	0.061	0.075	0.038
Other oils/fats	0.002	0.000	0.041	0.000	0.029	0.000
Groundnuts	0.014	0.000	0.051	0.007	0.479	0.021
Fruits	0.049	0.133	0.287	0.243	0.135	0.009
Vegetables	0.024	0.030	0.186	0.147	0.483	0.214
Alcoholic beverages	0.000	0.000	0.026	0.014	0.000	0.000
N	92	175	101	54	48	12

Source: Reported in Alderman (1990).

Notes: Calculations are ratios of consumption from home production to total consumption. These differ from self-sufficiency ratios, which are ratios of total production to total consumption. Ratios for millet/sorghum consumption are calculated only for the savannah zone, since only small amounts are consumed in the other regions of the country.

Appendix Table 4 — Ghana: Percent of Rural Households Producing Major Food Crops, by Agroecological Zone and Expenditure Quintile

	Expenditure Quintile				
	1	2	3	4	5
Coast	(n=89)	(n=111)	(n=133)	(n=105)	(n=76)
Cassava	91.0	74.8	72.2	74.3	72.4
Yam	21.3	19.8	24.8	25.7	22.4
Cocoyam	23.6	18.0	21.1	33.3	32.9
Plantain	29.2	24.3	24.1	35.2	30.3
Maize	84.3	64.0	63.9	59.0	61.8
Millet/sorghum	0.0	0.0	0.0	0.0	0.0
Rice	4.5	4.5	0.8	0.0	1.3
Cocoa	7.9	10.8	5.3	14.3	11.8
Forest	(n=217)	(n=255)	(n=221)	(n=174)	(n=66)
Cassava	95.4	89.0	95.0	87.9	86.4
Yam	55.3	51.8	54.3	55.2	50.0
Cocoyam	78.3	77.3	81.4	75.3	68.2
Plantain	80.2	79.2	87.8	78.7	75.8
Maize	90.8	86.3	86.4	82.8	81.8
Millet/sorghum	0.5	0.4	0.9	0.0	0.0
Rice	7.4	8.2	8.1	5.2	4.5
Cocoa	45.2	47.8	48.0	56.3	48.5
Savannah	(n=195)	(n=90)	(n=62)	(n=18)	(n=6)
Cassava	37.9	51.1	62.5	66.7	83.3
Yam	61.0	61.1	73.2	66.7	50.0
Cocoyam	0.0	0.0	0.0	0.0	0.0
Plantain	1.0	5.6	3.6	0.0	16.7
Maize	71.8	82.2	89.3	100.0	83.3
Millet/sorghum	94.9	77.8	73.2	55.6	66.7
Rice	48.7	36.7	26.8	33.3	16.7
Cocoa	0.0	0.0	0.0	0.0	0.0

Source: 1987-1988 GLSS.

Note: Quintile rankings are based on predicted per capita household expenditure calculated over the entire sample of households.

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