MSU International Development Working Papers

Understanding Linkages among Food Availability, Access, Consumption, and Nutrition in Africa: Empirical Findings and Issues from the Literature

by

MSU International Development Working Paper No. 46
1994

Department of Agricultural Economics
Department of Economics
MICHIGAN STATE UNIVERSITY
East Lansing, Michigan 48824

MSU INTERNATIONAL DEVELOPMENT PAPERS

Carl Liedholm and Michael T. Weber

Editors

The MSU International Development Paper series is designed to further the comparative analysis of international development activities in Africa, Latin America, Asia, and the Near East. The papers report research findings on historical, as well as contemporary, international development problems. The series includes papers on a wide range of topics, such as alternative rural development strategies; nonfarm employment and small scale industry; housing and construction; farming and marketing systems; food and nutrition policy analysis; economics of rice production in West Africa; technological change, employment, and income distribution; computer techniques for farm and marketing surveys; farming systems and food security research.

The papers are aimed at teachers, researchers, policy makers, donor agencies, and international development practitioners. Selected papers will be translated into French, Spanish, or other languages.

Individuals and institutions in Third World countries may receive single copies free of charge. Requests for copies and for information on available papers may be sent to

MSU International Development Papers
Department of Agricultural Economics
Agriculture Hall
Michigan State University
East Lansing, Michigan 48824-1039
U.S.A.

UNDERSTANDING LINKAGES AMONG FOOD AVAILABILITY, ACCESS, CONSUMPTION, AND NUTRITION IN AFRICA: EMPIRICAL FINDINGS AND ISSUES FROM THE LITERATURE

by

Patrick Diskin

July 1994

This paper is published by the Department of Agricultural Economics and the Department of Economics, Michigan State University (MSU). Funding for this research was provided by the Food Security II Cooperative Agreement (AEP-5459-A-00-2041-00) between Michigan State University and the United States Agency for International Development, through the Office of Economic and Institutional Development in the Economic Growth Center of the Global Bureau. Supplemental funding for this research was also provided to the FS II Cooperative Agreement by the African Bureau, through the Food Security and Productivity Unit of the Division of Food, Agriculture, and Resources Analysis, the Office of Analysis, Research, and Technical Support (ARTS/FARA/FSP). This report is also published as a *USAID Technical Paper* by the Office of Analysis, Research, and Technical Support, Bureau for Africa (ARTS).

Patrick Diskin is a Graduate Assistant in the Department of Agricultural Economics, MSU.

ISSN 0731-3438

Published by the Department of Agricultural Economics and the Department of Economics, Michigan State University, East Lansing, Michigan 48824-1039, U.S.A.

ACKNOWLEDGMENTS

The author gratefully acknowledges the benefit of comments on earlier drafts of this report by Kristy Cook, Brian D'Silva, Arthur Dommen, Philomina Gwanfogbe, Thomas Jayne, Rod Kite, Mattias Lundberg, Simon Maxwell, Frank Riely, James Shaffer, Shahla Shapouri, John Strauss, and seminar participants at Michigan State University. This report, while drawing from a number of various sources, is not exhaustive, and any comments, criticisms, and suggestions would be appreciated. Correspondences can be sent to P. Diskin, Department of Agricultural Economics, East Lansing, MI 48824-1039; Tel. (517) 353-7897; Fax (517) 432-1800; E-mail diskinpa@student.msu.edu

EXECUTIVE SUMMARY

This paper starts with the unsurprising observations that (1) having enough food available at national and local levels is *necessary but not sufficient* for ensuring that households have adequate access to food; (2) having adequate household access to food is *necessary but not sufficient* for ensuring that all household members consume an adequate diet; and (3) consuming an adequate diet is *necessary but not sufficient* for maintaining a healthy nutritional status.[1] Recognizing that the links from food availability to access to consumption to nutritional status are *not* automatic, the challenge for policy makers and analysts concerned with achieving food and nutrition security is to understand how these variables are linked to one another, how closely they are related in various contexts, and what the important intervening variables are which affect the linkages among these variables. Unfortunately, however, our ability to understand the nature and extent of the relationships among these variables in detail has been hampered by a lack of information as well as by concerns over the appropriateness of the analytical approaches and indicators that have been used in empirical studies of these issues.

While these observations are not new to most experts in food security policy analysis, they are nevertheless frequently overlooked by policymakers involved in the planning and implementing food security strategies. This paper tries to assist such policymakers in understanding and recognizing the importance of these issues by (1) bringing together many (though certainly not all) empirical findings from the literature regarding linkages along the food availability - nutrition pathway; (2) discussing issues about the appropriateness of the indicators, data, and analytical approaches used for generating these empirical findings; and (3) identifying implications of these findings and methodological concerns for improving food security strategies and analysis.

One important theme running through this paper is that gains in food access, consumption, and nutritional status may depend more on *how* gains in food availability, access, and consumption, respectively, are achieved than on *whether* they are achieved. For instance, increased food availability may **not** lead to increased food access, if the former is achieved in such a way that has negative effects on the real incomes of low-income households. Also, increased household access to food may **not** lead to increased food consumption for family members if the former is achieved in a way that results in adverse shifts in income or time allocation for household members more concerned with family food provision. And increased food consumption may **not** lead to improved nutritional status if the means by which consumption gains are realized have negative health effects that impair the body's ability to absorb and utilize ingested nutrients.

A second important theme of this paper is that more attention is needed on methodological issues associated with trying to empirically test linkages among availability, access, consumption, and nutrition. Particularly important are issues of indicator relevance, data reliability, sample selection and aggregation, requirement norms, unobserved variables, and choice of statistical constructs, which will be discussed during the course of the paper. Unless more care is taken by

[1] The terms *food availability, food access, food consumption,* and *nutritional status* are defined in section 1.3.

researchers in addressing these issues, there is the danger that so-called empirical findings may depend more on the methods by which the results are obtained than on the actual characteristics of the population under consideration. In addition, wide variations in the ways data are collected, samples are selected, and analyses are conducted impede researchers' ability to compare and generalize findings across samples. Better methodological agreement and coordination among researchers could reduce this problem.

These themes have a number of implications for both how to make and how to research food security policy issues. Some of these implications are summarized below:

Implications for Food Security Policymaking

1. Government strategies intended to increase national food production, such as parastatal food marketing boards or producer price supports, do not necessarily increase access (and the security of this access) to food, and in many cases worsen it. The effects of national food availability-oriented policies on the effective demand for food and the security of food access of vulnerable households should be considered carefully, and an automatic link between increased food production and increased food security should never be assumed. Assessing the impacts of policies on access requires careful empirical analysis of appropriately disaggregated household data.

2. The source and control of income can affect whether and the extent to which increased incomes for food insecure households lead to improved food consumption. Specifically, some studies have indicated that income generation characterized by migration, lump-sum payments, or less female control over income may reduce the consumption benefits of additional income. For example, IFPRI studies of agricultural commercialization in Kenya, Rwanda, and the Gambia found a deterioration in food security in more commercialized households, despite their higher incomes, because of shifting control of income from women to men. However, there are at least a couple of reasons for pausing before trying to apply these findings to policy design. The first is that effective policy instruments may be difficult to identify. For instance, even income which is directly paid to women in a project may end up in the control of husbands. But secondly, and perhaps more importantly, there are significant methodological concerns regarding these empirical studies which warrant further assessment before translating their findings into policy actions (see following section on research implications).

3. Women's time allocation is an important and frequently overlooked determinant of their, and their children's, nutritional status. Kennedy and Bouis (1993) suggest that "the household that allocates more time to food preparation and child care could enjoy better nutrition because of reduced morbidity, than if it had earned extra income and spent more for food." Income generation strategies should not assume that women's time is in abundance, and should strive to conform to household labor needs – for instance, activities which allow women to earn income at home (e.g. cooking, tailoring, gardening) may be a possibility. The use of time-saving household technologies (e.g. mechanized grain processing mills) should also be encouraged.

However, the purchase of such technologies may depend on who controls household income, as there is evidence that men are often unwilling to pay for them. The social constraints and nutritional benefits of such technologies need to be considered in policies affecting their availability.

4. Nutritional status depends, of course, on food intake, but in some cases, health conditions may be more constraining than food intakes on nutritional well-being. This was DeWaal's (1989) conclusion, for instance, in the case of the famine in Darfur, Sudan in 1984/85. *How* food consumption gains are realized may also determine whether, and to what extent, increased food consumption translates into improved nutritional status. For instance, technologies (e.g. irrigation) which increase food consumption, via increased agricultural productivity and farm incomes, may have adverse health side effects which outweigh consumption benefits, resulting in diminished nutritional welfare. Another example may be distributions of food aid that encourage migration to feeding camps where there may be serious problems of infectious diseases. DeWaal (1989), in fact, goes so far as to conclude that food aid played no role in preventing starvation in Darfur's 1984 - 85 famine, and that if, instead, "Darfur had been provided with clean water, better sanitation, and measles vaccination, most or even all of the famine deaths could have been prevented." While this conclusion seems exaggerated, the point that we must not only look at providing food as a solution to malnutrition is a good one.

Implications for Food Security Policy Research

1. Food security researchers need to more carefully define the variables they are purporting to analyze (this paper suggests some definitions) and explain how these conceptual variables relate to the proxy indicators used to measure them. For instance, anthropometric data (measurements of body size) should **not** be (as they often are) *implicitly* equated with nutritional status (the level of nutrients available to body tissues). Also, empirical studies are fraught with problems of data unreliability and unobserved variables, the implications of which are frequently overlooked.

2. Furthermore, because careful descriptions of exactly how data were generated, and the problems involved, as well as access to the raw data itself, are missing from most of the literature, readers are forced to engage in a lot of "blind faith" in accepting conclusions which the authors derive. Reducing the necessity of blind faith acceptance of results could be encouraged by agencies which fund research by requiring, for instance, that reports be attached by summaries of the raw data used in order that analyses may be replicated.

3. Empirical findings suggesting that low income elasticities of calorie consumption at sample (or sub-sample) mean income levels imply that income generation is only weakly linked with food consumption, are often very misleading. The elasticity at the mean for *any* sample (or sub-sample), no matter how it is disaggregated, will inevitably underestimate the elasticity facing the poorest households in the sample. Two possible alternatives are to calculate elasticities for only those below a certain minimal food consumption standard, or to calculate the number of people which cross the line from calorie deficiency to calorie adequacy as a result of changes in real

income. However, both of these alternatives face the very difficult problem of establishing what the requirement standards ought to be, as important inter-societal, intra-societal, and intra-individual differences exist in energy requirements.

4. The implications of male vs. female-controlled income for family members' food consumption and nutritional status needs more research before any substantial resources are devoted to this issue in the policy arena. More intrahousehold data would be useful, though expensive to collect. But less costly improvements in our understanding of intrahousehold allocation issues may be gained by reexamining the methods used in analyzing currently available data. In particular, when trying to show relationships between control of income and nutritional outcomes, more attention is needed on the issue of whether other factors not controlled for in the analyses may be responsible for any apparent correlations. For instance, regression models suggesting that women's control over income positively affects children's calorie intake has not always controlled for factors such as women's education level which could have positive affects on both control over income and calorie intakes. If so, an apparent correlation between control over income and calorie consumption might reflect this heterogeneity in education rather than any causal relationship between the two. While there certainly may be cases where men do not properly care for the well-being of their children, we must wary of jumping too quickly to intuitively-suspect generalizations about parents' caring for their children.

CONTENTS

LIST OF FIGURES

1. INTRODUCTION

1.1. The Need to Understand Availability - Nutrition Linkages

This paper starts from the premise that, *for the purposes of food security*,[2] having food available at national, or even local, levels is of little value **unless** households have access to it. Furthermore, the ability of households to access food is of little importance **unless** it leads to increased (or more stable) food intake (in the short and long run[3]) for dietarily-deficient household members. And finally, food consumption is of little use **unless** people are free from factors such as poor health or unsafe water which may reduce their bodies' abilities to absorb and utilize their ingested nutrients. Thus, this paper treats food availability, access, and consumption as necessary (though not sufficient) means towards achieving the ultimate food security objective of nutritional well-being.[4]

Policymakers in many African countries have long been concerned with designing policies and projects to assist households and individuals to achieve food security and nutritional well-being. Concern for eliminating food insecurity stems from both humanitarian and economic development reasons. Chronic undernutrition not only results in devastating losses of human life, but also drains a country's productive capacity, thus limiting its chances for economic growth. A lack of access to food results in individuals or families having low energy reserves and poor health, reducing their capacity for work and income generation. In children, undernourishment contributes to a slowing of physical and mental development, thus jeopardizing the productive capacities of future generations.

In addition, we must be concerned not only with the current food security and nutritional status of people, but also the security of that status. Even households which are not chronically short of food may suffer food shocks from time-to-time, shocks which may result in asset depletion or stunted growth from which it is difficult to recover. Also, fear of having inadequate access to food at some time can lead to households engaging in low-productivity, risk-averse strategies which inhibit economic development. For instance, low-income farm households may choose to

---

[2] *Food security* is defined as the ability of all people to have reliable access at all times to enough food to meet their basic dietary needs.

[3] Consideration of *long-run* food consumption is especially important, and often not given enough regard in studies of income-consumption linkages, as will be noted later in the paper. For instance, increases in income which do not translate into immediate increases in food consumption do not necessarily imply a failure in the income - consumption linkage, as the income may be saved or spent on assets which help secure future food consumption. Frank Riely, in a review of an earlier draft of this paper, termed this strategy of sacrificing current consumption in order to protect assets or future income "livelihood security."

[4] There are, of course, other important objectives that people and countries also pursue – e.g. education, peace, security, community, luxury goods, freedom from physical handicaps, etc. – but these other objectives will be regarded as being outside the scope of this paper.

grow their own food rather than plant other crops which might be more profitable on average, but which entail more year-to-year risk. If such farmers could be made to feel more secure about their ability to obtain food, even in bad times, through either more effective markets or direct government actions, they might be more willing to engage in these more productive, but riskier, ventures.

Despite the concerns of policymakers, widespread food insecurity and malnutrition have continued to plague hundreds of millions of people in Africa. One reason why this problem has continued is that governments and households face serious resource constraints. But, in addition to the resource constraints these countries face, efforts by policymakers to design effective food and nutrition security strategies have been constrained by a lack of reliable and relevant information concerning the causes of food insecurity, and their linkages to nutritional status. As a result, designing policies has too often become "an exercise in planning without facts" (Weber et al. 1988).

The conventional wisdom among many policymakers concerned with food security has been that high degrees of correlation exist between food availability and access, between food access and consumption, and between food consumption and nutritional status. In other words, increased food availability leads to increased access leads to increased consumption leads to increased nutritional well-being. Due in part to this "wisdom," efforts to solve the nutritional problems facing African countries have largely focused on strategies for promoting agricultural production, and sometimes income generation, with the implicit assumption that increases in production and incomes automatically lead to improved food consumption and nutritional welfare.

However, much evidence in the literature suggests that, in many cases, and for many reasons, assumptions of strong and straightforward linkages along the pathway from food production to nutritional outcomes are not well-founded. Many factors other than household food production and income, for instance, may affect rural food consumption (e.g. intrahousehold resource allocation patterns). Also, many factors other than food consumption may affect nutritional status (e.g. infectious diseases).

While there is no question that adequate food availability, access, and consumption are *necessary* conditions for attaining adequate food access, consumption, and nutritional well-being, respectively, there is also little doubt that the former conditions are *not sufficient* for achieving the latter. In particular, a number of cases suggest that *how* gains in availability, access, and consumption are achieved may matter more than *whether* they are achieved.

Jayne and Chisvo (1991), for example, found in Zimbabwe that government maize pricing and marketing policies increased domestic food availability but reduced food access for many low-income households by diminishing their purchasing power. Another example is findings by Kennedy and Cogill (1987) which indicated that for many Kenyan households the source, periodicity, and control of income may be more important for determining household food consumption (over limited ranges) than the amount of income gains. Also, in some cases,

technologies, such as irrigation, which increase food consumption, via increased agricultural productivity and farm incomes, may have adverse health side effects which outweigh any consumption benefits, resulting in overall diminished nutritional welfare (Kennedy and Bouis 1993).

Therefore, to develop appropriate food security and nutrition strategies, and to evaluate their effectiveness, policy analysts need to understand the processes which determine food security and nutritional welfare in various contexts. To do so, simplistic assumptions about the food availability - nutrition pathway need to be replaced with appropriately disaggregated empirical information, which carefully identifies the nature, extent, and causality among these food security and nutrition variables, in order to better understand what the primary factors are limiting food access, consumption, and nutrition, among the food insecure, and the appropriate policies or interventions for overcoming or mitigating these factors.

Understanding the linkages along the availability - nutrition pathway is also important for improving the quality and usefulness of food security and nutrition monitoring activities. Tucker et al. (1989) point out that in many countries food security-related data continue to be collected for unspecified reasons and with unknown reliability. A common problem limiting the usefulness of food security and nutrition data has been the use of indicators which are ambiguous with respect to the *causes* of changes in the level of the indicator. As a result, although such data may be useful for indicating the extent of problems, they often fail to reflect causal links to policy decisions needed to make the information more "actionable." For example, used alone, anthropometric measures fail to provide insights regarding appropriate interventions for fighting malnutrition problems, because they fail to distinguish among various causes of malnutrition, such as inadequate food, sanitation or health care.

Estimating the nature and magnitude of linkages between outcome measures of consumption and nutrition and other causally-related variables, can help improve our understanding of these processes. Rainfall, for example, if it is seen as strongly linked to food consumption, can indicate drought-caused food insecurity crises and perhaps suggest policies to address supply-side variability (e.g. food imports). Conversely, expenditure data may indicate failures of income and suggest demand-side measures (e.g. labor-based relief projects) (Tucker et al. 1989). Understanding the nature of consumption - nutrition linkages is also important to test the appropriateness of using food intake measures (especially those based on food expenditure data) as proxies for indicating nutritional status. An example is using estimates of elasticities of food expenditures or intakes in studies of income - nutrition linkages (Schiff and Valdes 1990a).

But consensus has not been easy to reach on the precise nature and magnitudes of these linkages, or their implications for policy. Schiff and Valdes (1990c), for instance, point out that "critical elements of the pathway from changes in income to its effect on nutritional status are still questioned." One reason for this lack of consensus, as just mentioned, is that the nature of these linkages may differ in different contexts. This raises the question of the generalizability of research findings. A second reason for this lack of consensus has been concerns and

disagreements over what the appropriate analytical approaches and indicators are for analyzing these linkages.

1.2. Issues Regarding Indicators, Measurement Errors, and Analytical Methods

The quality of estimates of the nature and magnitude of linkages among food availability, access, consumption, and nutrition depends critically on our using appropriate indicators, reliable data, and valid analytical methods. Disagreements among researchers regarding the degree to which these conditions have been met in various empirical studies, has led to considerable controversy in the food security linkages literature over the interpretation and meaningfulness of certain research findings.

One problem limiting the usefulness and validity of many research results is that conceptual inequivalence inevitably exists between variables of interest and their associated indicators. For example, while weight/height measurements and nutritional status may be correlated, they are not conceptually equivalent. In other words, they do not necessarily imply each other. Despite the obviousness of this point, such conceptual inequivalence is generally overlooked in practice. Researchers frequently make the leap from observations on anthropometric data to conclusions about nutritional status, without explicit recognition of the differences.

A second reason for indicators being inadequate proxies of underlying variables is the presence of data measurement errors. Sources of measurement errors may include imperfect recall or strategic behaviors by respondents, imperfect communication between respondents and enumerators, or miscalibration of measuring devices. A certain degree of measurement error is inevitable, but some indicators may face more serious measurement problems than others. Household income data, for instance, are criticized for their high degree of unreliability, relative to household expenditure data.

Conceptual inequivalence and measurement errors, in fact, are often tradeoffs. The more closely related an indicator is to its underlying variable, the more difficult and costly its measurement tends to be. This, of course, is the rationale behind using proxy indicators. For instance, "quantities of nutrients consumed" would be conceptually closest to what we are interested in when measuring food consumption, yet "number of meals eaten" is often used instead as a proxy because it is easier to measure.

The appropriateness of ways in which data are analyzed and interpreted is also a matter of concern. For instance, the usefulness of income elasticity of food consumption (expenditures or intakes) measures, as applied in a number of studies as a measure of access - consumption linkages is questionable. One reason is that elasticity estimates for household samples can vary widely depending simply on the size and socio-economic characteristics of the samples chosen. As a result, valid comparisons among data sets, or generalizations of findings, are not possible unless specific information identifying a household's income level, landholding size, place of residence (esp. urban vs. rural), or other factors that explain the varying relationship between

income and consumption, is available and controlled for. At the very least, the initial income or calorie adequacy levels of households need to be known and accounted for before meaningful inter-household or intersample comparisons regarding expenditure habits and consumption linkages can be inferred from elasticity estimates.

Aggregating and averaging data is also a problem. Often "elasticity" studies draw inferences from comparisons of elasticities estimated from mean levels of income, caloric intake, farm size, etc. over aggregated (either totally, or according to income groups or other divisions). An obvious limitation of this approach is that they tell little about those at the lowest income (or food consumption) levels. This is true (though less so) even if households are broken down into smaller income sub-groups (e.g. income quintiles). In fact, it would not be surprising to find an income elasticity of calorie consumption at the median income level of a group (or sub-group) of households to be nearly zero, while the elasticity for the poorest households might be nearly one.

An even more important criticism of elasticity of food demand estimates is that the responsiveness of food *intake* to changes in income, and the responsiveness of food *adequacy* to changes in income, are *not* the same (Ravallion 1990; Anand and Ravallion 1993). For example, a low income elasticity of nutrient intake does not necessarily imply that aggregate undernutrition (as measured by a "headcount" index) is unresponsive to income. This distinction between the responsiveness of food intakes and food adequacy to income changes would be especially evident in cases where a large proportion of the sample population is consuming food at or near the minimum requirement levels.

1.3. Definitions of Key Terms

Analyses of the nature and extent of linkages among food availability, food access, food consumption, and nutritional status may depend critically on how the variables are defined (Schiff and Valdes 1990c). Therefore, since these variables have been defined in various ways in the literature, it is important to define them here explicitly in order to avoid ambiguity.

Food Availability, in this paper, refers to the supply of food in a nation, region or locality. Sources of supply may include home production for consumption, domestic commercial food production, food stocks, imports, and food aid. Food availability as it is used here should **not** be confused with the term "household food availability," which is often used in the literature as a proxy for what is referred to in this paper as household food consumption.

Food Access refers to the ability of households to obtain food, whether its source be home production, commercial purchases, or transfers. It may be considered as roughly equivalent to "real household income" or "effective demand", with respect to the cost of some prescribed food basket. *Security* of food access, however, implies that we consider both current *and future* sources of production and income. Thus, physical and human assets are also important components of food access. Differential access within households is also important, but often

difficult to measure. We generally cannot measure, for example, control of income or assets by children.

Food Consumption refers to the quantity and quality of food intake by households or individual family members. Though often measured in terms of food expenditures, it is conceptually closer to "food intake" as measured by calories or broken down into different nutrients. Distinguishing between food expenditures and food intakes, as this paper does, helps avoid potential ambiguity, resulting from alternative interpretations of the term "consumption" by economists (who tend to think of expenditures) and, say, nutritionists (who would tend to think food intake). Also "household calorie (or nutrient) availability" is often used as a proxy for household-level food consumption. Food consumption should not, as is sometimes done in the literature, be equated with nutritional status, a problem pointed out by Schiff and Valdes (1990c).

Nutritional Status refers to people's physical state outcomes as a result of the ingestion, absorption, and utilization of nutrients by their bodies. Nutritional status, thus, depends not only on food intakes, but also on the body's ability to utilize these nutrients, which may be influenced by health factors unrelated to food intake levels. Anthropometric data (measurements of body size) have often been used as measures of children's nutritional physical state outcomes. But anthropometry and nutritional status should **not**, as they often implicitly are, be regarded as conceptually equivalent or *necessarily* correlated. In other words, for example, one child having a lower weight/height (or some other anthropometric measure) than another does not necessarily mean the former is less well nourished.

2. CONCEPTUAL FRAMEWORK

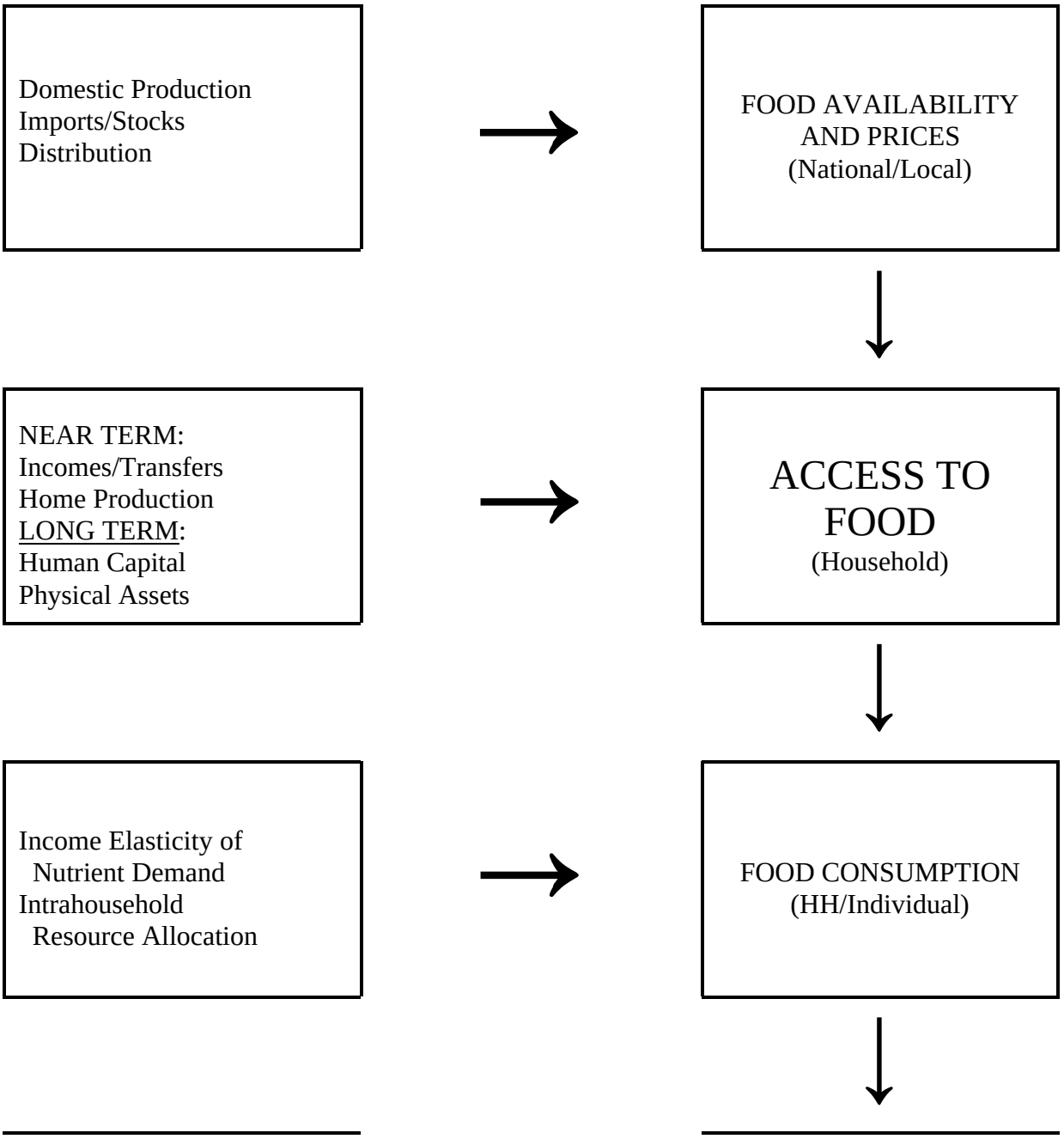
Figure 1 outlines the conceptual framework this paper will use for analyzing the linkages among food availability, access, consumption, and nutrition, as well as important direct intervening variables, that will be discussed in this paper. Income plays a key role in this framework. Securing adequate access to food depends largely on having adequate income (subsistence or market) or other entitlements (e.g. food transfers). Income growth also permits (but does not guarantee) greater provision of, and access to, other requirements for nutritional well-being, such as safe water, environmental sanitation, and health care.[5]

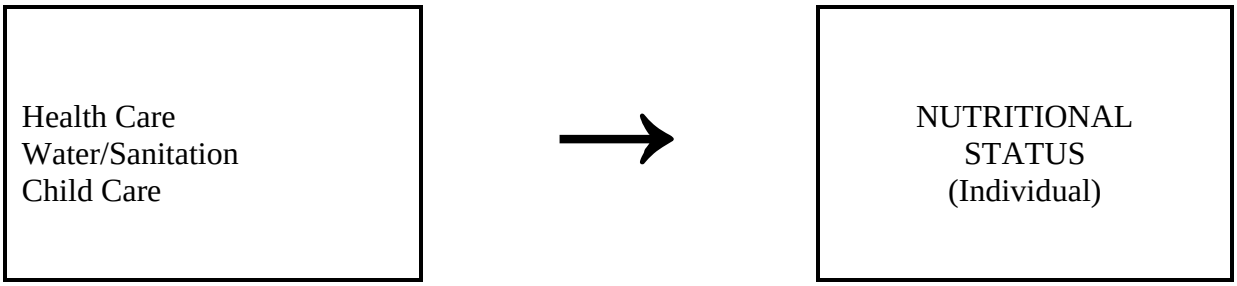
Since African economies depend heavily on agriculture, food production may be a key sector for generating income growth. Increased agricultural productivity (e.g. via technological change) can *potentially* increase food access for low-income households in two ways – by increasing incomes (e.g. crop sales, labor wages, consumption of subsistence production) and/or by lowering real food prices. Together, incomes, food availability, and prices are important determinants of food access, which, in turn, is a potentially important means for improving consumption and nutritional well-being.

However, the importance of a number of intervening variables which may weaken the links among these path variables are also recognized. The extent to which national or local food availability translates into adequate access for households, for instance, depends, in the short run, on their incomes and other entitlements, and in the long run, on their physical and human assets. The degree to which changes in household access, in turn, are translated into changes in consumption levels for individual family members, depends on the household's income elasticity of nutrient demand and the distribution of resources among household members. Finally, the degree to which changes in consumption levels translate into changes in nutritional status may be affected by factors such as child care, sanitation, access to health care, and access to safe water.

[5] Since figure 1 is meant only to show the *direct* effects at each stage along the linkages pathway, this income - nutrition linkage via health status is not indicated.

Figure 1. Linkages from Food Availability to Nutritional Status





3. AVAILABILITY - ACCESS LINKAGES

3.1. Empirical Findings

Food insecurity and malnutrition, at least until recently, have primarily been viewed by policy makers as a food availability problem (Franklin and Harrell 1985). And food availability, in turn, has often (and often mistakenly) been viewed as a food self-sufficiency problem – i.e. meeting domestic food needs with domestic food production (Frankenburger 1992). As a result, government food security strategies have often (at least implicitly) emphasized increasing national-level food availability through expanded domestic food production as the key means for addressing food and nutrition insecurity problems – e.g. the dissemination of "Green Revolution" technologies (Kennedy and Bouis 1993; Harriss 1987).

Food availability is, of course, a prerequisite for food access, and domestic production is one means for achieving adequate availability. However, domestic production strategies are *not necessarily* the best means for ensuring availability, as many economists have shown that having some reliance on imports may be a less costly way of procuring domestic food needs (e.g. Jayne and Rukuni 1993). Moreover, increased food availability at national or regional levels by no means ensures increased household-level access to food. As Sen (1981) argues, "starvation is the characteristic of some people not *having* enough food to eat. It is not the characteristic of there not *being* enough to eat."

Numerous recent studies, in Africa and elsewhere, have shown that an adequate supply of food at the national level is no guarantee against hunger (Jayne and Chisvo 1991; Kennedy and Haddad 1992; Sarma and Gandhi 1990; Sen 1981). In fact, widespread hunger is common even in some countries which produce surplus food for export. The World Bank observes that "it is common to have 20 to 30 percent of a country's population consuming less than 80 percent of caloric requirements even though national-level food availability is at or greater than 100 percent" (cited in Kennedy and Bouis 1993). For example, in Zimbabwe, an almost perennial net exporter of grain, widespread inadequate access to food and chronic malnutrition have persisted throughout the 1980s despite a "threefold expansion of grain sales by smallholders ... and overflowing state grain silos" (Jayne and Chisvo 1991).

It is clear that food insecurity and famines result from lack of purchasing power, rather than simply lack of availability. Nevertheless, strategies to increase national and regional food availability and food production may be linked to improved food access by stimulating broad-

based growth in rural household incomes (both farm and non-farm), and by reducing food prices (for net food buyers). Thus, to the extent that policies or interventions, such as the dissemination of improved agricultural technologies, can improve incomes or food prices for low-income or food insecure households, they can be successful in reducing hunger in African households (Kennedy and Bouis 1993).

The role of food prices may be particularly important for producers and consumers. Food prices have a strong influence on real incomes for poor consumers because a large share of their incomes (often 60 - 80%) is spent on food (Sarma and Gandhi 1990; Sen 1981; Hussain 1990; Pinstrup-Andersen 1987; Senauer 1990; Alderman 1986). Sen (1981), for instance, argues that famines in Bangladesh and Ethiopia in the 1970s were not caused by absolute declines in available food, but rather by food price inflation which depleted the purchasing power of low-income households.

Alderman found in Ghana, however, that responses to food prices differed by region, and in some cases, price increases were correlated with increases in household food consumption. Presumably, these households were net food sellers – thus the price increases were associated with increased real incomes for these households. Another reason for differences in responses to food price increases is that food baskets may differ across regions and households, as well as across time. For instance, food grains might be more expensive in urban areas but this price difference may not be so important because non-grain consumption might be more important in the diet relative to rural areas (Ravallion 1990; von Braun et al. 1993).

But the link from agricultural growth to broad-based income growth and food security is *not* an automatic one. Not only does increased production not necessarily lead to improved food security, it may even exacerbate food insecurity. The *means* by which food production gains are achieved are important. Policies, for instance, which encourage greater production among large-scale producers, but hurt the purchasing power of low-income producers, would exacerbate, rather than reduce, food insecurity. For instance, MSU research conducted in Rwanda and in Zimbabwe (see case example) have demonstrated that although government marketing or pricing policies may stimulate food production and rural income, leading to modest supply increases, they may also exacerbate food insecurity for the poorest rural households who (contrary to the conventional wisdom among many policymakers and researchers) are often net buyers, rather than net sellers of food, and, consequently, are hurt more than helped by higher food prices. These households, it has been shown, may rely on non-farm activities or non-food cash crops for an appreciable share of their incomes and on food purchases, rather than production, for a large share of their consumption.

3.2. Methodological and Measurement Issues

Efforts to estimate the extent to which food availability is linked to food access is hindered by a number of measurement problems. For instance, as Hay (1978) points out, "while it is relatively easy to estimate imports and the amount of domestic production which enters the market through

official channels, it is uncommonly difficult to estimate informal transactions, black market dealings and leaks across the border to a neighboring state." Moreover, such estimates of *commercial* food availability do not account for the great proportion of food in many African countries which is produced for home consumption, and thus "does not pass through commercial channels where it might be (easily) monitored" (Poleman 1983). Such production for home consumption is by no means necessarily correlated with changes in commercial (market) food availability.

Food production estimates are an alternative to estimating food availability through market supply estimates. This approach, too, entails serious difficulties, and these difficulties may vary in different contexts, according to the varying complexity involved in estimating outputs. For instance, Poleman (1983) cites a finding that estimates of irrigated rice production (which is relatively easy to measure) in Malaysia and Sri Lanka may have underestimated calorie availabilities by 10 - 15%. And he notes that such undercounting may be far worse elsewhere. As Poleman points out, "output that is not seen is not counted, and if communications are poor, a great deal is not seen." Production estimates may be particularly difficult in tropical areas where "many food crops are not grown in pure stands but mixed-planted in fields of bewildering complexity" (Poleman 1983).

Another methodological problem concerns our interpretation of the causes of price changes. Lower prices, for instance, may be the result of increased supplies or decreased effective demand. Alderman (1992) notes that it is not possible to separate the effects of rising food prices from falling incomes, both of which would be likely in bad crop years. Alderman also noted that consumers can avoid absorbing the full brunt of food price changes by substituting toward lower-priced foods. He found that the variability of commodity prices (about 45-65%) far exceeds variability of costs of the average diet (about 9-17%), suggesting cross-commodity substitution towards lower value crops (e.g. root crops). Such cross-commodity substitution further complicates the job of inferring changes in food availability from changes in food prices.

While these and other problems with measuring food availability may be quite serious, measuring access is even more problematic. These difficulties in measuring access are discussed later in section 4.2.

3.3. Case Example: Zimbabwe

Zimbabwe, a net exporter of maize for 20 of the past 22 years, can be considered a food production success story in Africa (Jayne and Rukuni 1993). However, this success in achieving national-level food self-sufficiency (in most years) has not translated into adequate access to food for many households. In what they call a "food insecurity paradox," Jayne and Chisvo (1991) found that widespread inadequate access to food and chronic malnutrition have persisted in Zimbabwe despite a "threefold expansion of grain sales by smallholders since 1980 and overflowering state grain silos."

This food insecurity paradox, Jayne and Chisvo show, has been due in large part to government pricing and market regulation policies which, while encouraging agricultural growth and abundant grain supplies, have eroded the purchasing power of low-income (or grain-deficit) rural households. This has occurred because most of these poor rural households (contrary to the conventional wisdom among many policymakers and researchers) are net buyers, rather than net sellers of food. Furthermore they frequently face serious resource constraints which limit their ability to respond to the higher producer prices with increased production. Consequently, these households, which tend to rely on non-crop activities for a large part of their incomes, and on food purchases for a significant part of their consumption, are hurt, rather than helped, by higher food prices.

That both increased food availability and reduced food access can result from the same policies is a strong lesson for policymakers **not** to *assume* that strategies to increase food supplies will *necessarily* improve food security. Not only does increased production not guarantee improved food security, it may even exacerbate food insecurity, if the policies promoting the increased production have deleterious effects on the real incomes of vulnerable households (e.g. because of increased food prices). As this Zimbabwe case shows, the *means* by which food production gains are achieved may matter more for food security than whether they are achieved.

4. ACCESS - CONSUMPTION LINKAGES

4.1. Empirical Findings

Many studies support the intuitive notion that wealth, income, and price levels are important determinants of how much food households and individuals consume (e.g. Kennedy and Cogill 1987; Srinivasan 1983; Bouis and Haddad 1990; von Braun, Puetz, and Webb 1989; von Braun, de Haen, and Blanken 1991; and von Braun et al. 1993; Ravallion 1990; Haddad, Sullivan, and Kennedy 1992). But this conclusion has not been without debate, as studies have also shown that increased household access to food does not necessarily lead to increased consumption for undernourished family members (e.g. Alderman 1992; Kennedy 1991; Behrman and Deolalikar 1987).

Empirical analysis of the linkages between determinants of food access, such as household income, and food consumption for individuals can be broken into two parts: (i) the extent to which increases or decreases in household access (or real income) lead to increases or decreases in household food consumption and (ii) how equitably food consumption is divided among individuals within the households.

4.1.1. Household-Level Access - Consumption Linkages

Two measures commonly used for estimating how changes in determinants of household access are related to changes in household food consumption are the "elasticity of food expenditures" and the "elasticity of food intakes." The former estimates how percentage changes in an access determinant (e.g. prices, incomes, landholdings) affect percentage changes in food *expenditures* (measured in monetary units, and including both consumption of home production and market purchases). The latter estimates how percentage changes in an access determinant affect percentage changes in food *intakes* (measured in units of calories or other specific nutrients, and often using "household food availability" as a proxy). For example, the "income elasticity of vitamin A intake" would mean the estimated percentage change in vitamin A intake resulting from a given estimated percentage change in household income.

Using data from household recall surveys, numerous studies have attempted to estimate income elasticities of food demand for household samples in Africa and elsewhere. These include:

- Kennedy and Cogill (1987) in Kenya;
- Alderman and Higgins (1992) in Ghana;
- Rogers and Lowdermilk (1991) in Mali;
- von Braun et al. (1989) in the Gambia;
- Bouis and Haddad (1990) in the Philippines;
- von Braun, et al. (1991) in Rwanda;
- Ravallion (1990) in Indonesia and;
- Behrman and Deolalikar (1987) in India.

Studies have also considered how food consumption is affected by landholdings (Tschirley and Weber 1994; von Braun, de Haen, and Blanken 1991; Bouis and Haddad 1990) and food prices (Alderman and Higgins 1992; von Braun, Puetz, and Webb 1989). Not surprisingly, these studies have generally found positive average income elasticities of food consumption. However, the precise estimates of these elasticities have varied widely from near zero to near one. Alderman (1992); von Braun, Puetz, and Webb (1989); and von Braun, de Haen, and Blanken (1991) found quite high income elasticities for calorie consumption in Ghana, the Gambia, and Rwanda, respectively. For instance, von Braun, de Haen, and Blanken (1991) found in their Rwandan sample that "for an average household a 10 percent increase in income leads... to a 10 percent increase in the consumption value of food (i.e. income elasticity of food expenditures = 1), and to an increase of 5 percent in calorie consumption (i.e. income elasticity of calorie intakes = 0.5)" (pg. 13, parentheses added). Such results might suggest that income transfers and employment generation are highly appropriate policy objectives for food security.

Contrary to these results, however, Kennedy's (1989) study on impacts of sugarcane production in Kenya found that "although the increased income associated with sugarcane production translates into improved caloric intake for the household, the link between income and calories is significant but weak" with an income elasticity of calorie demand of only 0.15 at mean levels of caloric consumption.

Care must be taken in how these results are interpreted and compared, however, because estimates of the strength of access - consumption linkages are highly sensitive to the estimation methods used. For instance, it is clear that income elasticities of food demand can vary widely among samples due simply to differences in their relative income or calorie adequacy levels. People who are dietarily satisfied are not likely to spend much of any additional income they earn on food. Thus, as many studies have shown, elasticities of food demand are substantially higher for the lowest income (or least calorie adequate) households than for the highest income (or most calorie adequate) households (Schiff and Valdes 1990c; Senauer 1990; Alderman 1986; Alderman and Higgins 1992; Schnepf 1992; Sarma and Gandhi 1990; Ravallion 1990). This has important implications for interpreting the meaning of results, particularly when using elasticities calculated at mean income levels. These implications, as well as other empirical issues concerning the use of such elasticity estimates, are discussed in more detail in section 4.2.

One of these issues to be discussed further in the next section is whether it is more important to consider "elasticities of food expenditures" or "elasticities of nutrient intakes." Studies have shown wide differences between estimates of these two types of elasticities (Behrman and Deolalikar 1987; von Braun, Puetz, and Webb 1989; von Braun, de Haen, and Blanken 1991; Bouis and Haddad 1990; Senauer 1990; Schnepf 1992). For instance, as noted above, von Braun, Puetz, and Webb (1991) found the income elasticity of food expenditures equal to 1 for the average household in their Rwandan sample, while the income elasticity of calorie intakes was only equal to 0.5. Likewise, von Braun, Puetz, and Webb (1989) found in the Gambia that estimates for these alternative elasticity measures were 0.94 and 0.48 respectively. Even more dramatically, in Asia, Bouis and Haddad (1990) estimated the average income elasticity for food

expenditures for a sample of Philippino households to be 0.65, while the elasticity for calorie intakes was only 0.11.

The difference between the results for these two types of elasticity measures suggest that as incomes increase, families choose to switch to higher priced (per calorie) foods (e.g. meats, fruits, processed foods) in order to improve variety, taste, convenience, and perhaps (though not necessarily) nutritional quality (Kennedy and Bouis 1993). For instance, in the Rwandan study just mentioned, von Braun, de Haen, and Blanken (1991) found that households in the wealthiest income quartile of their sample spent 77 percent more per calorie than did households in the poorest income quartile. In Bouis and Haddad's (1990) Philippino sample, households in the highest expenditure quintile spent 60% more per calorie than did households in the lowest expenditure quintile.

An important issue emanating from the observed differences between these two elasticity measures is whether the greater expenditures per calorie that are associated with higher incomes reflect increased nutritional quality, or instead other taste or convenience attributes which might have neutral or even adverse nutritional consequences. The issue of dietary quality has become increasingly important in Africa, especially with urban migration and the growth in consumption of convenience and highly processed foods. Von Braun et al. (1993) provide the following examples of the effects of urbanization in Africa on food consumption patterns and dietary quality:

- reduced breastfeeding leading to kwashiorkor and diarrheal diseases;
- increased consumption of white bread and polished rice leading to reduced vitamin B intake and problems of beriberi;
- shifts in consumer tastes towards wheat, rice, and maize, and away from more traditional staples such as sorghum and millet;
- increased preference for more highly milled, but less-nutritious, grain;
- more food eaten outside of the household (e.g. roadside stands); and
- greater preference for foods which are easy and quick to prepare.

An important reason for these changes in food consumption and preferences has been the increasing scarcity and value of women's time. Abdi (1992) (cited in von Braun et al. 1993) found in Côte d'Ivoire, for instance, that "the opportunity cost of women's time was ... positively correlated with household expenditures on bread and rice, and negatively correlated with expenditures on traditional staples such as maize, cassava, and yams, which require more preparation." The importance of women's time for food consumption patterns is further supported by Jayne and Rubey (1993) who found in Zimbabwe that women with lower opportunity costs of time were relatively more likely to wait in milling queues for "straight-run" meal than to buy more refined (and less nutritious) maize meal in shops.

4.1.2. Intra-Household Food and Income Allocations

The preceding discussion has considered the extent to which changes in determinants of household food access lead to changes in household food consumption. But changes in household-level consumption do not necessarily parallel changes for each individual household member, as intrahousehold distribution is also important. Age and gender status within the household may be an important determinant of how much access individual family members may have to food brought into the household (Wise 1992). Evidence has revealed that inequities in food distribution within families in many countries have favored men over women, first-born over later-born children, and working age adults over the elderly (Behrman 1992; Garcia and Senauer 1992; Staatz, D'Agostino, and Sundberg 1990; Wise 1992; Kennedy and Bouis 1993; Garcia and Pinstrup-Andersen 1987). In South Asia, for instance, some evidence suggests that boys often get larger allocations of food than girls.

While there is little evidence in Africa of such biases for boys over girls[6] (Svedberg 1990), some studies have indicated that children and women are likely to consume a lower proportion of their caloric requirements than other household members (Kennedy and Bouis 1993). Also, Strauss and Mehra (1989) found in a Côte d'Ivoire study "that a child's relationship to the head of the household is important in determining the extent of child wasting and stunting (and) whether the wife is the senior wife of the household head as opposed to a junior wife or a household head wife, may be an important proxy for intrahousehold bargaining power."

A number of studies have suggested that household food intake is a poor proxy for individual intakes, as correlations between them may be quite low. Wise (1992), for instance, cites research by Garcia and Senauer (1992) from IFPRI which indicated that linkages between household and individual food consumption measures are quite low in the Philippines, with the correlation between preschooler calorie adequacy and household calories per capita estimated to be only 0.42. None of the household-level indicators measured in their study were determined to be good proxies for the nutritional status of individual high-risk members of the households in the Philippines food subsidy pilot program. Wise also cites Staatz, D'Agostino, and Sundberg (1990) who found that individual nutritional well-being could not be accurately measured by household level indicators.

Unfortunately, little is known about the relationship between what is produced and purchased by whom, and what is actually consumed by individual family members (Wise 1992). Researchers

[6] In fact, some evidence suggests the opposite. Kennedy and Cogill (1987) and von Braun, Puetz, and Webb (1989), for instance, found in Kenya and the Gambia respectively, that male children fared far worse than females on nutritional measures, contrary to the results found in many parts of Asia. This suggests differences in child sex preferences between the two regions. A possible explanation may be that the perceived economic value of female children is relatively higher in Kenya than in Asia, because of bride prices and greater household labor contributions. Svedberg (1990) in an analysis of secondary anthropometric data from many African countries also finds that females do at least as well or even better than males in most cases, and attributes this to the greater importance of female agricultural labor in Africa relative to Asia.

have seldom tried to measure food consumption by *individual* family members with some exceptions (e.g. Haddad and Kanbur 1990; Behrman and Deolalikar 1987; and Pitt, Rosenzweig, and Hassan 1990). Instead, surveys of African households have tended to merely observe total household consumption, and use inherently untestable assumptions about distributions within the household (Thomas 1992; Hoddinott and Haddad 1991).

An important question addressed in the literature has been to what extent do increases in household calorie intakes correlate with calorie intakes for children. For instance, Kennedy (1989) found in a Kenyan study that although increases in household income and calorie consumption is associated with increases in children's calorie intakes, the link between them is weak. In fact, Kennedy and Bouis (1993) observe that "a doubling of household income in Kenya and the Philippines resulted in an increase in preschooler energy intake of only 4 percent and 7 percent, respectively. This was in areas where the child's diet was 20 to 30 percent below recommended levels. Thus, quite large percentage increases in household income would be needed to fill the energy gap via the income/household calorie/child calorie link."

Bouis and Haddad (1990) have also pointed out in their Philippines study that a large share of "the extra calories that were available at higher incomes went to adults, who were already meeting their recommended intakes of calories.[7] Preschool children (once breastfeeding had been stopped) at all income levels consumed well below their recommended calorie intakes .... Regressions show calorie intakes of preschoolers to be positively and significantly related to their nutritional status. Yet higher-income households choose to purchase nonfood items and higher priced calories at the margin, while preschoolers continue to consume well below recommended intakes."

The findings from Kenya and the Philippines in the previous paragraphs may certainly warrant a reassessment of the methodology used. These results may be consistent with a number of causes, in addition to the possibilities implied by these analyses of widespread callousness or ignorance by parents regarding their children's needs (a suggestion which seems intuitively unlikely to this author). While there may be behavioral factors involved, there may also be methodological reasons for these findings. In particular, we should consider closely the issue of the appropriateness and validity of the Recommended Daily Allowance standards being used. This issue is discussed further in the following section on methodological issues.

Another complexity in examining links between household food consumption and individual intakes is that calorie estimates, which are most commonly used for estimating dietary adequacy, may not be good indicators for overall nutrient intake quality. Kennedy and Payongayong (1992a) have pointed out that increases in household or child calorie consumption may be paralleled by increases in some micronutrients but not others. In Kenya, for instance, vitamin A deficiencies often exist where calorie intakes are adequate. Also, in Indonesia, Kennedy and Bouis (1993) report evidence which shows "that vitamin A consumption was low in

[7] However, Strauss (1993) points out that this could be due to higher incomes being associated with higher physical exertion which could make energy requirements higher than so-called "recommended" calorie intakes.

communities with low prevalence rates of protein-energy malnutrition; conversely, communities with a high prevalence of protein-energy malnutrition, in general, had adequate consumption of vitamin A." They also point out that "vitamin A is particularly important because it is a nutrient known to be lacking in large segments of the child population ... (and) has been shown to be associated with decreased mortality and, in some cases, a decrease in morbidity."

Another issue is that different types of household income may have different consumption effects, as the source, periodicity, and control of income may all effect the extent to which income gains lead to food consumption gains. Mason et al. (1985), for instance, observe that in most cases where the link between income and consumption fails, it is because "the *source* of income changes: for example when people migrate to towns, or change agricultural practices." Empirical evidence of the importance of income sources and periodicity is also provided in a study of Kenyan households by Kennedy (1989). (See Kenyan case example in section 4.3.).

In many cases it may be particularly important to consider who controls household income. Researchers have often treated African households as if they were homogenous decision-making units with common and non-competing interests. But such a unified household model ignores important intra-household differences in roles, responsibilities, and access to resources which affect how much food households obtain and individual family members consume. As Wise (1992) reports, "men and women in African families often have separate incomes and expenditures, and there is little pooling of a couple's or household members' income in the Western sense." There are many examples, in fact, of husbands paying wives for labor, or of husbands and wives having separate bank accounts, assets and expenditures. Polygamy and competition among wives are also common in some areas.

A reason why such non-pooling of household income may be an important factor for understanding access - consumption linkages is the wealth of evidence, from Africa and elsewhere, suggesting that women in poor households are more likely to spend additional income on food than are men. If this is the case, sources of income which give relatively more control to women, as opposed to men, would be likely to have a greater impact on household food consumption (especially for children) (Behrman 1992; Wise 1992; Thomas 1992; Hoddinott and Haddad 1991; Kennedy and Cogill 1987; Staatz, D'Agostino, and Sundberg 1990; Rogers and Youssef 1988; von Braun, Puetz, and Webb 1989). Strauss (1993), however, cautions that the evidence on differential spending habits between the genders should be considered mixed, as the results in some of these studies are subject to alternative interpretations.[8]

Much of the support for the hypothesis that income controlled by women is more likely to be spent on food consumption than that controlled by men, comes from empirical studies done by IFPRI. For example, a study of Kenyan households, found that the greater the proportion of income which came from production of food for home use (which came primarily from land controlled by women), the greater were the beneficial effects on consumption and on nutritional

[8] Forthcoming research by Strauss will cover this topic in much more detail.

status. Conversely, greater percentages of household income from non-farm sources (which are generally controlled by men) were associated with lower caloric consumption and nutrition (Kennedy and Oniang'o 1990). Also, in a household survey in Côte d'Ivoire, a doubling of women's share of household cash income was associated with a 2.2% rise in the budget share allocated to food, and a fall of 25.5% and 14.2% respectively in the budget shares of alcohol and cigarettes. Children's nutritional indicators also were better in households where females had greater income shares (Hoddinott and Haddad 1991). And in the Gambia, von Braun, Puetz, and Webb (1989) found that a drop from 30% to 10% in women's share of cereal production, was associated with a 2.2% decrease in calorie consumption in the wet season.

Similar results have been found outside Africa. Data from a budget survey in Brazil, for instance, revealed that increases in *unearned* income[9] (e.g. pensions, gifts, asset earnings) for women led to much greater improvements in calorie and protein intakes (and nutritional status) for household members than did increases in unearned incomes accrued to men. For calories these income effects differed by a factor of 11 (Thomas 1992). And a pilot food subsidy program in the Philippines found that a husband's wage rate had a positive effect on his relative calorie share and that of the wife, but a negative impact on the children's food allocation. On the other hand, an increase in the wife's wage increased the relative calorie allocation to herself and her children, but decreased the husband's share (cited in Wise 1992; originally Garcia and Senauer 1992).

These differential impacts of male- and female-controlled income can have important implications for how to design and evaluate income-related projects or policies for improving food security. For instance, proponents of commercial agriculture contend that increased commercialization can improve food intakes and nutritional status through increased incomes. But a review of IFPRI studies on agricultural commercialization in Kenya, Rwanda, and the Gambia observed that because cash crop income is generally controlled by men, there can be a deterioration in food security in more commercialized households, despite the income gains from cash crops, because of the shifting control of income from women to men (Kennedy and Bouis 1993).

Thus, it is clear that the common assumption that households are homogenous units working toward common interests and goals, with a single decision maker who allocates resources in ways that are equally beneficial to all members, is invalid. The source of income gains, and who has control over them, matters. In addition, to understand consumption patterns, it is important to distinguish between the food procurement and preparation responsibilities of men and women within households, and the constraints each face. However, such gender considerations are generally missing in income - expenditure - consumption studies (Wise 1992). This failure to account for these differences can result in ill-conceived policies and erroneous conclusions regarding the impacts of household income on food consumption for individual family members. Wise (1992), in fact, argues that the assumption that what benefits the household in the

[9] The implications of using only *unearned* income are discussed in section 4.2.

aggregate, benefits the needs of individual members, is partly responsible for the persistence of hunger and malnourishment in the world.

However, testing *how far* wrong this unified household assumption is, has been empirically difficult, and appropriate data are scarce (Hoddinott and Haddad 1991; Wise 1992; Behrman 1992). There are a number of methodological issues and limitations, however, associated with trying to empirically analyze intrahousehold resource allocation issues. For instance, one problem with testing the hypothesis that women spend their income differently than men, is that it is not possible to empirically distinguish between "re-allocations of expenditures in response to differing allocations of time, or differences in preferences amongst household members" (Hoddinott and Haddad 1991). These methodological issues are discussed further in section 4.2.

Nevertheless, evidence from studies in Kenya and Malawi does suggest that, in some cases, how much income a household has may be *less* important for family members' food consumption than who controls the income. Specifically, in a survey of low-income Kenyan households, Kennedy (1991) found that preschoolers in male-headed households, which have higher incomes on average, are more likely to be stunted or low weight-for-age than those in female-headed households. However, the Kenya data also revealed that the lowest-income female-headed households, contrary to conventional expectations, had lower levels of pre-school malnutrition and higher levels of preschooler calorie consumption than higher income female-headed households, suggesting that other factors besides male vs. female control are also involved.

Similarly, Kennedy (1991) found in Malawi data that both calorie consumption and nutritional status were higher on average in the lower-income de facto female-headed households than in the relatively higher-income male-headed households. Surprisingly, however, contrary to the hypothesis that women have higher propensities than men to spend income on food, preschoolers from the so-called "migrant female-headed households," which had even higher incomes than the average male-headed households (as well as the categories of female-headed households), had the lowest calorie consumption and highest malnutrition prevalence (Kennedy 1991). Thus, as was also suggested in Kennedy's Kenya analysis, the relationship between women's income and calorie consumption may not be so simple.

Staatz, D'Agostino, and Sundberg (1990) also observed that the relationship between control over income for women and family food consumption is not so straightforward. Their evidence from a sample of Malian households, indicated that those households in which women sold a greater share of the products from their fields, were more likely to have nutritionally-deficient children, despite the greater availability of income for the women in these households.

One factor that may be important for explaining these findings from Kenya, Malawi, and Mali is the effects that income generating activities have on women's time allocation, and the implications for food purchase and preparation decisions. Processing and cooking requirements for traditionally-consumed coarse grains, for instance, are generally time-intensive. Increasing opportunity costs of women's time mean less time and energy available for meal preparation, or

changes in dietary patterns towards more conveniently prepared foods which may be less nutritious.

The use of grain processed in small mechanized grain mills has been suggested as a time-saving food preparation method allowing women (who are generally responsible for food preparation) to have more time available for income generating, child care, and other activities. However, because it is higher priced and its time-saving benefits accrue mostly to women, evidence has shown that the purchase of such processed grain has been limited largely because men are unwilling to pay for it. As Wise (1992) notes, "money to pay for grain processing almost always comes from women's revenues and ... in all but a few exceptional cases, women's income generating activities are severely constrained." Since income generation is, itself, limited by time constraints, the resulting vicious cycle is obvious.

4.2. Methodological and Measurement Issues

4.2.1. Data Constraints and Measurement Errors

A major problem in the debate over the nature and extent of the relationship between food access and consumption has been a lack of useful empirical data for measuring these linkages. Because of this scarcity of data, Poleman (1983) concludes that "there is still not enough evidence about the effect of income on food behavior for us to generalize with confidence."

One reason for this paucity of data is that there are a number of measurement problems which make conducting such surveys of either income or food consumption difficult. Hay (1978) observes that household and individual consumption surveys have "the reputation of being not only high in cost but also low in reliability." For instance, two problems with estimating food consumption for individual family members are that it is difficult to measure caloric intakes for children receiving breastmilk, or for individuals eating from a common family pot (Kennedy 1989). One alternative to surveys which directly estimate food intakes is to calculate "household calorie availability" which uses information on home food production, food purchases, food sales, gifts, and changes in food stocks to estimate food intakes. But the combination of errors in the estimates of each of these variables raises serious reliability concerns, as well.

Measuring income is also fraught with difficulties. The use of household surveys in which respondents self-report their incomes (or expenditures as a proxy for income) has been the most common approach for monitoring income. The reliability of income survey data has been seriously questioned, however. Such reliability problems may result from reasons such as imperfect recall by respondents and imperfect communication with surveyors, but also because respondents are likely to engage in strategic behaviors (responses) if they perceive that such things as tax payments or eligibility for public assistance will be based on their survey answers or observed behaviors. That is, respondents may try to exaggerate their poverty in order to pay less taxes or receive more aid. Poleman (1983), for instance, observes that surveying farmers may lead to underestimates of output since "the statistical officer in developing countries is

frequently (and not irrationally) equated with the tax collector by the farmer, whose response will be to minimize production." (See also Kenyan case example in section 4.3.).

Because of reliability concerns, many recent household income studies have used expenditure data as a proxy for income (Thomas 1992). Expenditure data are generally more reliable than income data because of fewer reporting errors and because less subject to shocks. A study by Haddad, Sullivan, and Kennedy (1992), for instance, found that household total expenditures and food expenditures were both more closely correlated than household income with indicators of calorie adequacy. However, another study revealed that expenditure data have been shown to have an appreciable upward bias in estimated expenditure elasticities whereas income data have potential downward biases (Alderman 1992).

4.2.2. Problems Associated with the Use of Income - Calorie Elasticity Estimates

The use of measures of income elasticities of food expenditures or intakes for estimating the strength of access - consumption linkages is especially controversial. One reason is that, as mentioned in the previous section, elasticity estimates for household samples can vary widely depending simply on the size and socio-economic characteristics of the samples chosen. Ranges for individual households would, of course, be even wider than ranges among sample averages. As a result, the usefulness of such elasticity estimates for assessing the strength of income - consumption linkages may be quite limited.

In other words, the percent change in calorie consumption (expenditures or intakes) with respect to percentage changes in income depends very much on what the original level of calorie consumption is, and what populations are included in the sample. How the sample is segmented is of course critical. That is, for most food security policy we are only interested in the elasticity estimates for specific groups (i.e. those which are [most] calorie deficit). Establishing exactly who are included in these groups, however, is very difficult.

One result of this problem is that valid comparisons among data sets, or generalizations of findings, are not possible unless specific information identifying a household's income level, landholding size, place of residence (esp. urban vs. rural), or other factors that explain the varying relationship between income and consumption, is available and controlled for. At the very least, the initial income or calorie adequacy levels of households need to be known and accounted for before meaningful interhousehold or intersample comparisons regarding expenditure habits and consumption linkages can be inferred from elasticity estimates. Using the examples from the previous section, for example, rather than implying that access and consumption are more closely linked in Ghana, Rwanda, and the Gambia, than in Kenya, the lower consumption elasticity in Kenya is more likely to be the result of households in the Kenyan sample having higher incomes and calorie adequacy than those in the Ghanaian, Rwandan, and Gambian surveys.

Aggregating and averaging data is also a problem. Often these "elasticity" studies draw inferences from comparisons of elasticities estimated from mean levels of income, caloric intake, farm size, etc. An obvious limitation of this approach is that they tell little about those at the lowest income (or food consumption) levels. In fact, depending on the income levels of the households in the sample, it would not be surprising to find an income elasticity of calorie consumption at the mean income level of the sample to be nearly zero, while the elasticity for the poorest households might be nearly one. As Ravallion (1990) argues, "it is clear that in developing countries we are far more concerned about changes in calorie intake for people whom we deem to be undernourished than for those who are not. And for those who are poorly nourished, one can rightly be more concerned about those who are a long way from an adequate intake than those who are quite close to it."

One solution to this problem has been to divide households according to income levels – for instance, into income quintiles. Another possibly useful approach would be to only include households with intakes below some certain consumption cut-off point. Also, other disaggregations of data, besides income, may be very important for correctly understanding and interpreting elasticities of food demand. For instance, results may differ by location. In particular, income elasticities of calorie intake have been found to be greater in rural areas than in urban areas (Ravallion 1990). And the rate at which these elasticities decline as incomes grow is greater in urban areas than in rural areas (von Braun et al. 1993).

An even more fundamental and important criticism of the use of elasticity of food demand estimates to assess the linkages between income and food consumption is raised in Ravallion (1990) and Anand and Ravallion (1993). They point out that the responsiveness of food *intake* to changes in income, and the responsiveness of food *adequacy* to changes in income, are *not* the same. For example, a low income elasticity of nutrient intake does not necessarily imply that aggregate undernutrition (as measured by a "headcount" index) is unresponsive to income.

This distinction between the responsiveness of food intakes and food adequacy to income changes would be especially evident in cases where a large proportion of the sample population is consuming food at or near the minimum requirement levels. As Ravallion (1990) describes, "the marginal effect of a change in the incomes of undernourished households on a headcount index of undernutrition is determined by the product of the income slope of nutrient intake and the slope of the cumulative distribution function of intake, evaluated at the nutrient norm." When much of the sample is near minimum requirement levels, this latter slope will be high. As a result, even small changes in nutrient intake resulting from changes in income levels, could lead to large changes in headcount assessments (i.e. the number of people with adequate food consumption). Thus, in such a case, even if income elasticities of nutrient demand are low, as long as they remain positive, changes in income may still have significant effects on the extent of malnutrition, and we may still "remain optimistic about the prospects for eliminating nutritional deprivation by raising incomes of the poor."

This point can perhaps be further illuminated with a simple hypothetical example. Imagine a community in which one-half of the population has an adequate diet, and the other half is at only 98% food adequacy due to income constraints. If, let's say, the entire population obtained 10.0%

increase in real income, we might expect an increase in food consumption of about 2.0% for half the population, with little or no increase in the other half, yielding an average increase of food intake over the total population of about 1.0%. Thus, we would estimate the elasticity of food intake for the overall population to equal 0.10, and for the low income group to equal 0.20. On the other hand, if we looked from the perspective of attainment of calorie adequacy, we might observe that the number of people with adequate diets has doubled, or in other words, increased by 100%. Thus, we would estimate the elasticity of food adequacy for the overall population to equal 10.0, and for the low income group to approach infinity. The point is that while income gains in the population may lead to only small increases in aggregate food consumption, it may lead to large reductions in the number of people facing undernutrition when food intakes are at or near their minimum recommended levels.

Another issue concerning elasticity of food demand estimation is whether we should measure how food *expenditures* increase with higher incomes (i.e. the "income elasticity of food expenditures"), or go further to include the effects of changes in expenditures on changes in food intakes by measuring how household calorie *intakes* (or household calorie availability as a proxy) respond to changes in income (i.e. the "income elasticity of calorie intake"). As noted in the previous section, studies have shown wide differences between estimates of these two types of elasticity measures. Neither type of elasticity measure is perfect, and the difference may (though not necessarily) represent a quantity - quality tradeoff. That is, "elasticity of expenditures" does not tell us whether calorie/nutrient consumption itself is increasing. And "elasticity of intake" in addition to being more difficult to measure, may not reflect quality differences which may, in many cases, be more important than simply increasing the quantity of consumption, particularly true if only calories (and not other nutrients) are measured. Of course, a greater elasticity of expenditures does not guarantee increased nutritional quality either, as higher costs or improved taste or convenience attributes may be what is behind the increased expenditures.

4.2.3. Problems Regarding the Appropriateness of Calorie Requirement Norms

Another methodological problem is the lack of appropriate (and appropriately disaggregated) caloric requirement standards (or RDAs) for the sample populations being considered. Standard requirements are generally prescribed by nutritionists in organizations such as the FAO or the World Health Organization. Methodological weaknesses of this approach, however, are recognized by experts from these organizations who warn that "such comparisons, though always useful, cannot in themselves justify statements that undernutrition, malnutrition or overnutrition is present in a community or group, as such conclusions must always be supported by clinical or bio-chemical evidence." (Srinivasan 1983)

This need for valid RDAs is important both for using the headcount index approach suggested by Ravallion, as well as for interpreting analyses such as those by Kennedy (1989) and Bouis and Haddad (1990) which suggest that parents are not spending much of their additional household income on food for their children, despite their children consuming far less than their dietary "requirements." One problem, however, in establishing appropriate RDAs is that

individual calorie requirements may vary widely across individuals, societies and occupations, as well as across time. For instance, those who are employed may have greater energy needs than those who are unemployed. Or those engaged in heavy physical labor may have greater energy needs than those working in sedentary office jobs (see Kenyan case example in section 4.3.). Furthermore, evidence increasingly shows that even people of the same age, sex, size, environments, and activity levels may have significantly different energy requirements (Srinivasan 1983).

Such differences in requirements may be substantial and failing to account for them can lead to erroneous conclusions, impairing our ability to understand the causes and extent of malnutrition problems (Randolph et al. 1991). It has been argued that RDA measures based on the U.S. population are inappropriate for African populations (Poleman 1983). But even if an African standard RDA were developed, important intra-society (e.g. inter-occupational) differences may exist which can lead to misinterpretations of data. In addition, intra-individual (intertemporal) calorie requirement differences may exist because of the body's ability to adapt in the short run to fluctuations in caloric intake (Edmundson and Sukhatme 1990).

Srinivasan's (1983) verdict on the validity of using recommended food intake requirement estimates is even harsher, concluding that "a biological basis for defining a fixed energy requirement for humans *does not exist*. Nor is the evidence for attributing undernutrition mainly to inadequate energy intake beyond doubt ... Naive comparisons of average energy requirements and average intakes of subgroups of populations (as for instance, income or expenditure classes, rural and urban population, etc.) such as those made (by) the World Bank ... should rightly be discarded as meaningless."

Since the poor in developing countries have been found to spend more time engaged in strenuous physical labor (Edmundson and Sukhatme 1990) and less time on leisure (Strauss 1985, cited in Randolph et al. 1991), consumption adequacy may likely be overestimated among the poor, and underestimated among the wealthy, if average, rather than differentiated, requirements are used (Randolph et al. 1991). This may explain the findings by Bhalla (cited in Schiff and Valdes 1990) which showed that, "according to FAO/WHO norms, 67% of U.S. males and 80% of U.S. females have a calorie intake below requirements!" Since women have been shown in some studies to spend more time in physical labor, and less time in leisure, than men, their nutritional requirements may also be underestimated and, thus, the adequacy of their consumption overestimated.

On the other hand, such a tendency to underestimate calorie adequacy among the poor when using *average* requirements may be mitigated by human regulatory processes which lower the body's energy needs in times of reduced food intake. That is, the human body may respond to reduced energy intake by increasing energy efficiency (Edmundson and Sukhatme 1990; Srinivasan 1983). As a result, the less one eats, the less one needs.

4.2.4. Problems with Measuring Intrahousehold Resource Allocations

There are also a number of methodological difficulties with trying to test hypotheses concerning intrahousehold allocation issues, or the magnitude of their importance. For instance, as mentioned earlier, it is difficult to measure individual nutrient intakes for children who are receiving breastmilk, or are eating from a common family pot.

Measuring how much control different family members have over income, in order to test hypotheses of whether women spend their income differently than men, is even more complicated. One problem is how to determine, in households where there is more than one parent, how much relative control over income each parent has. For instance, when a woman goes to the store to make a purchase, is she acting on her own preferences, or rather acting on instructions, explicit or implicit, from her husband or someone else. As Gittelsohn (1992) observes, household allocative behaviors (i) frequently occur "behind close doors" making them difficult to observe; (ii) are often sensitive in nature making them difficult topics to survey; and (iii) are made up of many little activities, making them difficult for respondents to recall.

One way of avoiding these problems has been to simply compare single (female) parent households with those in which a male parent is present. The latter households are often implicitly assumed to be "male-headed" households in which the fathers make most or all of the spending decisions. This assumption may be dubious unless supported by sociological evidence. Other analyses have tried, despite the methodological hazards, to go further and differentiate, in two (or more) parent households, between income controlled by men and that controlled by women. This may be done, for example, by assuming that subsistence income from crops on land cultivated by women is controlled by women, whereas, say, cash crop income is controlled by men. Or non-farm income may be assumed to be controlled by the parent earning the wage. In some cases, these approaches may be reasonable, in other cases not. A problem is that little evidence exists regarding the validity of such approaches in various contexts.

But even where the amount of household income under a particular parent's control can be reasonably established (e.g. one-parent households), a second problem is how to avoid biases resulting from the difficulty, mentioned earlier, of empirically distinguishing between reallocations of expenditures caused by differing allocations of time, and those caused by differences in preferences amongst household members (Hoddinott and Haddad 1991). That is, results which suggest that increases in income controlled by women lead to greater increases in food expenditures than equal increases in income controlled by men, might be due to increased purchases by women of higher-priced foods which require less preparation time (since the opportunity cost of their time is increased), rather than being due to inherent preferences for spending more money on food. In fact the effect of increasing opportunity costs of women's time could have adverse consequences on the nutritional quality of food such that calorie and nutrient intakes may be even less, despite greater food expenditures (Franklin and Harrell 1985).

One approach to this methodological problem has been to count only *unearned* income.[10] Because it is independent of *current* household labor decisions, this measure may be useful for abstracting from the price effects that wages would represent (i.e. the opportunity cost of time). However, this approach suffers from at least four drawbacks. First, unearned income rarely accounts for a significant share of total household income (Hoddinott and Haddad 1991; Behrman 1992). Second, it is likely to be subject to severe measurement error (Hoddinott and Haddad 1991). Third, current unearned income is often related to past *earned* income and labor decisions, implying that results which could be interpreted to suggest that women's income has more positive effects on consumption than men's income, might instead simply reflect that income controlled by more productive women has more positive effects on consumption than income controlled by less productive women (Behrman 1992). Fourth, unearned income may be a one-time event (e.g. gifts) and thus be less likely to indicate permanent income.

[10] Unearned income refers to such income sources as pensions, gifts or earnings on assets, which do not result directly from one's own labor.

4.3. Case Example: Kenya

Kennedy and Cogill (1987) and Kennedy (1989) examined the nature and extent of access - consumption linkages in a pair of studies on the consumption and nutrition impacts of sugarcane production in Kenya. Contrary to IFPRI findings in other countries, these studies revealed that increased access to food, as proxied by income, does not always lead to substantial increases in food consumption. In particular, Kennedy (1989) concluded that "although the increased income associated with sugarcane production translates into improved caloric intake for the household, the link between income and calories is significant but weak" with an income elasticity of calorie demand of 0.15 at mean levels of food consumption. Increments in incomes achieved by those households in the sample which shifted to commercial sugarcane production, were spent mostly on non-food purchases such as housing and education (Kennedy and Cogill 1987).

As discussed in section 4.2. of this paper, however, there are serious methodological concerns involved in calculating and interpreting such elasticity estimates. In particular, it is important to know whether the sample population and the data analysis methods sufficiently account for those low income households most afflicted by food insecurity. In these IFPRI studies, random samples were chosen from a district (South Nyanza) which had the highest infant mortality rate in all of Kenya. However, while selecting the most malnourished district is appropriate to focus on the more vulnerable households, using the income elasticity of calorie demand calculated at *mean levels of calorie consumption* may not be. Since the average percentage of energy-deficient households at different phases of the survey tended to be around 30-40%, using the elasticity at mean consumption levels may mask the importance of income for increasing consumption for these calorie deficient households. This may account for why income effects on calorie intake appeared so low in this study.

The studies also examined intrahousehold allocation issues. In particular, the studies found that the amount of income spent on food consumption may depend on whether the income is controlled by men or by women (Kennedy 1989). Specifically, the greater the proportion of income from production used for home consumption (which comes primarily from land controlled by women), the greater were the beneficial effects on consumption and on nutritional status. Conversely, greater percentages of income from non-farm sources (generally controlled by men) had a negative effect on caloric consumption and nutrition (Kennedy and Oniang'o 1990). In fact, their findings suggest that the amount of household income (within a narrow range of the sample) may be *less* important for family members' food consumption than who controls the income. However, a methodological concern with this interpretation is that the shadow price of home-produced food may be lower than the market price of purchased food (Strauss 1993).

The Kenyan studies also illustrated a number of methodological concerns. For instance, a finding which seemed surprising at first glance was that merchants in the sample population on had higher average income than landless laborers, yet had a higher prevalence of households consuming less than 80% of food intake norms. To explain this seemingly counter-intuitive result, Kennedy and Cogill reasoned that instead of the lower merchant household food intakes indicating true caloric deficits, a more plausible explanation was that intake needs are less for merchants because of their more sedentary lifestyles. This observation points out the hazard of relying on overly-aggregated dietary requirement standards, rather than having separate standards for distinct population sub-groups expected to have different nutrient needs.

Kennedy (1991) also cautioned against overly simplistic analyses of gender differences in spending patterns which treat "female headed households" as an homogenous entity, and suggest that such households need to be divided according to types (e.g, *de jure* vs. *de facto*) in order to be analytically useful. Specifically results of the Kenyan analysis indicated, quite surprisingly, that the lowest income (i.e. de facto) female headed households had *higher* levels of preschooler calorie consumption than did the higher income de jure households.

It is also important what components of food consumption we measure. The studies showed that calorie consumption was *in*adequate for indicating overall nutrient adequacy. In particular, vitamin A deficiencies often existed despite adequate calorie intakes (Kennedy and Payongayong 1992b).

How incomes are measured was also shown to be important. A finding that merchant household surveys revealed an almost two-fold difference between income per capita and expenditure per capita, due most likely to perceived incentives by these households to underreport actual income in order to avoid taxation, emphasized the methodological hazards of such surveys.

An additional point of importance for understanding access - consumption raised is the finding that caloric intake of preschoolers is related to the number of meals they eat. This finding supports the hypothesis that "small children are physically unable to eat large enough portions of bulky foods at one time to provide the calories they need" (Kennedy 1989). This highlights the importance of considering the effects of income generating activities on mothers' time allocation, since the number of meals a mother can feed her child may be limited by her time constraints.

5. CONSUMPTION - NUTRITION LINKAGES

5.1. Empirical Findings

As stated earlier, nutritional status is defined as a physical state outcome of the body's ingestion, absorption, and utilization of nutrients. Adequate food consumption only guarantees the first part of this process – i.e. ingestion. Thus, while food consumption is, of course, necessary for nutritional well-being, it is not sufficient. Other health factors also determine nutritional welfare by influencing the body's ability to absorb and utilize nutrients. Diarrhoeal diseases, in particular, can affect an individual's nutritional status by reducing appetite, reducing the body's effectiveness in absorbing nutrients, and increasing the body's consumption needs (Kennedy and Bouis 1993; Lutter et al. 1992). Diarrhoeal diseases, which may be associated with factors such as environmental sanitation, drinking water quality, health care access, and quality of child care, are particularly important in affecting the degree to which food consumption levels and nutritional welfare are correlated. Unless proper health conditions prevail, nutritional status may be fairly unresponsive to changes in food consumption (Wolfe and Behrman 1983; von Braun, de Haen, and Blanken 1991; Kennedy and Cogill 1987; Alderman 1992; Harrell, Parillon, and Politi 1990; Harrison 1988; Srinivasan 1983; Edmundson and Sukhatme 1990; Ravallion 1990; Wise 1992; Kennedy and Bouis 1993).

The relative importance of food consumption vs. other health factors in determining nutritional status (which is generally indicated by anthropometric measures such as weight/height, height/age, or upper arm circumference)[11] is debated in the literature (Lutter et al. 1992). For instance, a study in the Philippines found calorie intakes of preschoolers to be positively and significantly related to their nutritional status (Bouis and Haddad 1990). But other evidence suggests that increased food consumption may be neither the sole, nor even the most effective, cure for nutritional problems, as the effects of water safety, environmental sanitation, health care access, and other community and household health factors, may be quite substantial (von Braun, de Haen, and Blanken 1991; Srinivasan 1983; Chisvo and Jayne 1992). (See Rwanda case example, section 5.3.)

Alderman (1992) found in Ghana that estimated household calorie availability (a food consumption proxy) did not have any significant explanatory effect for nutritional status of children, whereas predicted illness, parents' heights, mother's education, and household size were significantly correlated. However, Alderman points out that this finding might *not* be due to food consumption and nutrition being unrelated, but rather due to household calorie availability being an inadequate measure of either dietary quality or intrahousehold distribution.

---

[11] Although anthropometric measures are commonly used to represent nutritional status, this paper does question the appropriateness of these measures, as well as the failure of researchers to adequately address the implications of the differences between anthropometric data and true nutritional status, for the interpretations of their results. However, for now this section cites findings linking food consumption to anthropometric indicators, saving a more critical discussion of the use of anthropometry for section 5.2.

And DeWaal (1989), in his study of the 1984-1985 famine in Darfur, Sudan, claims to find that nearly all cases of severe malnutrition resulted from disease rather than lack of food consumption. He argued that despite food shortages, food aid played no role in preventing starvation, and that if, instead, "Darfur had been provided with clean water, better sanitation, and measles vaccination, most or even all of the famine deaths could have been prevented." An important observation supporting DeWaal's assertion that good health is more important than food consumption for nutritional well-being, is that many calorie-deficit households who had both the market access and purchasing power to buy more food, but chose not to because they were more concerned with avoiding health crises associated with migration, due to poor water and sanitation quality and increased exposure to diseases.

While several reviewers of an earlier draft of this report find DeWaal's conclusions suspect, or at least overstated, many of his arguments are quite compelling. But DeWaal's observations obviously cannot be interpreted to mean that food access is not an important nutritional determinant. As one reviewer put it, you cannot live off of a clean toilet alone. But food access is also important because hunger, or the threat of it, is often what eventually induces families to migrate to areas where they become susceptible to disease. Secondly, hunger and disease are often mutually-reinforcing factors, and may not always be clear which is the first cause. Thus, the most valuable lesson of DeWaal's findings is not whether or not the level of food access is an important nutritional determinant, but rather their suggestion of the need to reconsider the *pathway* by which failures of food access may lead to malnutrition.
It is thus essential when evaluating the nutritional impacts of food security policies and projects, to consider the impacts on health factors in addition to effects on income and food consumption, especially since these impacts may be opposite in nature. The sources of income gains which make the food consumption gains possible are important to consider. Migration to cities, or changes in agricultural practices, for instance, may be associated with negative health factors that negate any food consumption benefits (Mason et al. 1985). For example, irrigation technology in Sub-Saharan Africa, which is important for increasing agricultural productivity and stability, has been associated with serious negative health consequences, such as increased incidences of cholera, malaria, schistosomiasis, and river blindness (Kennedy and Bouis 1993).

The effects of food consumption and health factors are not independent, however. Their relationship is synergistic in that undernourishment and illness tend to occur together, and their combined negative effects on nutritional status are worse than the sum of their individual effects would be (Lutter et al. 1992). This means that the importance of adequate food intake for nutritional well-being is even greater when health status is poor, and the importance of good health for nutritional well-being is even greater when consumption is inadequate.

Studies on children's nutritional status also suggest that both food consumption and health factors are important. Birth weight, considered the single most important determinant of child mortality and child growth up to the age of seven, is linked to a number of maternal nutritional factors, including preconception weight, weight gain during pregnancy, and morbidity (Kennedy and Bouis 1993). Inadequate weight gain during pregnancy, in turn, can occur when labor demands exceed calorie intakes.

In a Gambian study, for example, "birth weights were below average only after the peak period of agricultural labor; during non-peak seasons, birth weights were close to international norms" (Kennedy and Bouis 1993). Beyond birth, a three-country study in Egypt, Kenya, and Mexico by Kennedy and Bouis (1993) indicated that "disease patterns were the key determinant of how well a child grew in the first years of life, (and that) in order to have dramatic influence on decreasing malnutrition in the short to medium term, agricultural policies and programs have to be promoted in tandem with health and sanitation programs in rural areas."

Mothers' education has also been suggested as an important determinant of children's nutritional outcomes (Kennedy and Bouis 1993). However, maternal education may be best viewed as affecting child nutrition indirectly through factors such as child care and household income, without having separate direct effects. Supporting this view, Behrman and Wolfe (1987), using household data from Nicaragua, found no significant effects of maternal education on nutrition, once maternal and community endowments, in addition to nutrient intake, health and sanitation conditions, and health care access, were controlled for. In addition, Wandel and Holmboe-Ottesen (1992) found that nutrition education in schools and clinics had no significant effects of nutrition in their Tanzanian household sample because women felt such education "did not fit with their perception of health and disease and did not pay attention to their circumstances." This conclusion is not without debate, however, as many other studies "have shown that maternal literacy and schooling are associated with improved child nutrition after controlling for the effect of education on income and fertility." (McGuire and Popkin 1989).

One reason why it is important to understand consumption - nutrition linkages is to test the appropriateness of using food intake measures (especially those based on food expenditure data) as proxies for indicating nutritional status. An example is using estimates of elasticities of food expenditures or intakes in studies of income - nutrition linkages (Schiff and Valdes 1990a). On the one hand, it has been suggested that using food intake measures in such studies overestimates the importance of income in determining nutritional status, as the responsiveness of nutrition levels to income changes in poor countries may be far less than income elasticities of calorie demand (Wolfe and Behrman 1983; Kennedy and Cogill 1987; Edmundson and Sukhatme 1990). For example, consumer substitution towards higher priced foods with better taste or convenience attributes (e.g. more highly refined meal), but without nutritional benefits, may lead food intake elasticities to exaggerate the nutritional effects of income (Ravallion 1990).

Also, human regulatory mechanisms which allow energy expenditure (and efficiency) to adapt to nutrient intake (especially in short run) may reduce the direct correlation between nutrient intakes and nutritional status (Edmundson and Sukhatme 1990; Ravallion 1990). In this case, estimates of the effects of income on nutrition which use nutrient intakes as a proxy may exaggerate the nutritional impacts of income because income also affects nutrient requirements. However, the income-nutrient requirement correlation is not necessarily positive. The source of income may also be important, because, for instance, income gains associated with less strenuous work effort could reduce nutrient requirements (Ravallion 1990).

On the other hand, Schiff and Valdes (1990a) argue that the bias may go the other way – i.e. the effects of income changes on nutrient intakes may underestimate the effects on nutrition. In particular, they criticize Behrman and Deolalikar's (1987) article "Will Developing Country Nutrition Improve with Income?" for purporting to examine the impact of income on nutrition based on income elasticities of nutrient intake rather than of nutrition itself. Schiff and Valdes contend that this approach implicitly assumes that nutrition is directly proportional to nutrient intake and is not significantly affected by other food and nonfood factors. They contend, instead, that since a sustained increase in household income is likely to be accompanied by increased demands for food quality, improved food preparation, improved sanitation, more health care and better child care that the impact of income on nutrition (and health status) may be significant even though nutrient intake may remain unchanged or increase only slightly. This view is also echoed by von Braun et al. (1993), who further note that simple measures of calorie intakes (which do not account for micronutrients and food quality) may not be closely associated with nutritional status.

The debate over the appropriateness of using elasticities of nutrient intake as a measure of the effects of income on nutrition can have significant implications for policy analysis and decisions. Behrman and Deolalikar (1987), for instance, conclude that for income to have an impact on nutrition, policies are needed which raise the income elasticity of nutrient intake. Schiff and Valdez (1990a), however, contend that a low income elasticity of nutrient demand is not in itself a cause for concern. In fact, they point out, "the opposite may be true, as it may indicate dietary adequacy in the sense that these households can increase their intake of nutrients but prefer to spend additional income on other food attributes (which may *potentially* improve nutrition). Only in the extreme case of famine (or for households facing extreme poverty), with all income spent on the cheapest foods, would the level of nutrient intake be a relevant measure of nutrition, and raising that level would become the social priority"[12] (Schiff and Valdes, 1990a).

Attention has also been given in the literature to the relationships between women's working conditions and time allocation on children's nutrition. This issue is potentially important for evaluations of the impacts of food security policies, technologies, or projects. For example, because men and women in many African households have different labor and support responsibilities, new technologies or policies may affect intrahousehold allocations of labor. For example, Kennedy and Bouis (1993) cite findings which indicate that the introduction of mechanical technology for rice production in Sierra Leone slightly decreased the mean number of hours worked by men, while the amount of time required for female labor increased by 50 percent. Franklin and Harrell (1985) have also been critical of many food and nutrition programs which have failed to achieve their desired impacts largely because they assumed that human time was "an underutilized and low value resource which is plentiful and must be used more extensively."

However, the evidence in the literature on the importance of women's time allocation on nutrition has been partial and conflicting (Bennett 1988). Some studies have suggested that,

[12] Words in parentheses added.

despite the resulting increases in family incomes, women's participation in work activities, in their fields or outside the home, has overall adverse consequences for their children's nutritional well-being, because mothers with heavy work loads have less time to devote to food preparation, household sanitation, breastfeeding and other aspects of child care (Kennedy and Bouis 1993; Rabiee and Geissler 1992; Abbi et al. 1991). Kennedy and Bouis (1993) suggest that "the household that allocates more time to food preparation and child care could enjoy better nutrition because of reduced morbidity, than if it had earned extra income and spent more for food."

On the other hand, some researchers have shown that the negative effects on child care resulting from women working may not be as important as, or at least may be cancelled out or mitigated by, the positive effects of increased incomes or food production on household food access (Bennett 1988). In studies in Tanzania and Kenya, respectively, Wandel and Holmboe-Ottesen (1992) and Rubin (1990) found no significant relationship between the amount of mother's field work and children's nutritional status. And in India, Abbi et al. (1991) concluded that, although the risk of malnutrition for a child of a working mother was 1.7 times greater than that for a child of a non-working mother, low income was "the major detrimental factor, with the mother's working status being an aggravator."

Moreover, Bennett (1988) has criticized those studies showing lower nutritional status for children of working mothers for not having adequately accounted for family income levels or other important variables. Since women in developing countries often join the workforce only when faced with dire financial shortages (Rogers and Youssef 1988), "the poor nutrition observed among the children of working mothers in many of these studies may well be due to the conditions of poverty that drove the mothers to work in the first place and the low wages such women are able to earn, rather than to the fact of their working *per se*." (Bennett 1988)

5.2. Methodological and Measurement Issues

As is the case with the previously-discussed food security linkages, understanding linkages between consumption and nutrition is constrained by problems of inadequate indicators, measurement errors, and analytical controversies. In addition to the problems with measuring food consumption and requirements described above, two issues which are important to consider are (i) the degree to which anthropometric measurements and reference standards are useful indicators of nutritional status, and (ii) what variables ought to be controlled for when trying to estimate consumption - nutrition linkages. In particular, differences in the variables being controlled in various studies have led to numerous debates in the literature and have made comparing and generalizing findings among these studies difficult.

Tucker et al. (1989) cite a number of studies which question the reliability, consistency, and usefulness of anthropometric indicators. For instance, they cite Pelletier et al. (1985), who found (counter to what we would expect) that measures of H/A (a long-run nutritional status indicator) and W/H (a short-run nutritional status indicator) were negatively correlated in a study

of Philippines school children.[13] And Haaga (1986) showed in simulation experiments that minor measurement errors can yield serious downward biases (toward zero or negativity) in correlation coefficients calculated between H/A and W/H measures.

Tucker et al. also observe that an evaluation of Botswana's nutrition monitoring system showed that inaccuracies in weighing equipment and recording procedures led to large errors in prevalence estimates, and that errors in age estimates were found to be serious in Kenya and Bangladesh leading to an overestimation of prevalence bias. Also systematic relationships to mothers' education levels have led to overestimations of effects of mother's education on nutrition. Furthermore, clinic data may be biased because those living far from clinics may not use them and thus not be weighed (Tucker et al. 1989).

The appropriateness of the anthropometric standards being used is also important. A clear example would be the case of the Rwandan study by von Braun, de Haen, and Blanken (1991). This study compared anthropometric measures of a sample of Rwandan children to a standard developed by the World Health Organization - U.S. National Center for Health Statistics. But one may ask whether such comparisons of anthropometric measures offer meaningful conclusions about nutritional status. As the authors point out large differences in body size among Rwandans may be primarily determined by genetic rather than nutritional factors. Recognizing this casts doubt on the meaning of von Braun, de Haen, and Blanken's conclusion that "there is a clear indication that children in the households that consume less than 80 percent of the requirements show a worse nutritional status than children in households that consume above the 80 percent cutoff point." In other words failing to meet the 80 percent anthropometric standard could be the result of genetic characteristics, rather than inadequate consumption. And consuming below 80 percent of "requirements" may be due to having smaller body sizes (and hence food requirements) rather than being inadequate. The credence of this alternative interpretation of von Braun, de Haen, and Blanken's results is strengthened by their observation that their findings "are pronounced in the height-for-age and weight-for-age indicators, but not in the weight-for-height indicators."

The literature suggests that conclusions regarding consumption - nutrition linkages can depend largely on the variables the researchers choose to include in the analysis and how the analysis is done. For instance, as mentioned above, Alderman (1992) found in data from Ghana that estimated household calorie availability had no significant explanatory effect for children's nutritional status. However, he pointed out that this finding was more likely due to household calorie availability being an inadequate measure of dietary quality and/or intrahousehold distribution, rather than an indication that consumption and nutrition are unrelated. Also, other debates such as the importance of mother's education (e.g. Behrman and Wolfe 1987; McGuire and Popkin 1989) or time allocation (e.g. Bennett 1988) as determinants of nutritional status have largely resulted from differences in the variables that have been included in the analyses.

[13] This "contradiction" should not be surprising, however, given that height is in the numerator of the first expression and in the denominator of the second.

5.3. Case Example: Rwanda

Consumption - nutrition linkages in Rwanda were studied by von Braun, de Haen, and Blanken (1991) in another one of the IFPRI series on the food consumption and nutrition effects of agricultural commercialization. They found that positive effects of calorie consumption on nutrition were highly significant and larger than effects found in other IFPRI studies in Kenya, the Philippines, and the Gambia. However, the effects of health and sanitation variables on nutrition were much greater. Specifically, their data indicated that "doubling household calorie consumption from 1,500 to 3,000 calories per adult-equivalent – an extreme change indeed – would reduce stunting by about a quarter of a standard deviation ... whereas worm cure would have the same effect, and a clean latrine would have twice this impact on nutritional status."

This study is subject to many of the methodological concerns raised above, however, such as the accuracy of consumption and anthropometric estimates. In addition, the authors raise several other issues requiring additional exploration. For instance, they point out that further study is needed on how diet composition, rather than simply calorie intakes, affects nutrition. Also, investigation is needed on the effects of stable vs. sporadic consumption patterns. Furthermore, the methodological shortcomings of measuring only short-term impacts on nutrition, and failing to measure caloric requirements, are recognized. They suggest that it would not be surprising if a combination of the research's methodological shortcomings would lead to underestimations of the effects of food consumption on nutrition.

6. IMPLICATIONS FOR POLICYMAKING AND POLICY ANALYSIS

1. Government strategies intended to increase national food production, such as parastatal food marketing boards or producer price supports, do not necessarily increase access (and the security of this access) to food, and in many cases worsen it. The effects of national food availability-oriented policies on the effective demand for food and the security of food access of vulnerable households should be considered carefully, and an automatic link between increased food production and increased food security should never be assumed. Assessing the impacts of policies on access requires careful empirical analysis of appropriately disaggregated household data.

2. The source and control of income can affect whether and the extent to which increased incomes for food insecure households lead to improved food consumption. Specifically, some studies have indicated that income generation characterized by migration, lump-sum payments, or less female control over income may reduce the consumption benefits of additional income. For example, IFPRI studies of agricultural commercialization in Kenya, Rwanda, and the Gambia found a deterioration in food security in more commercialized households, despite their higher incomes, because of shifting control of income from women to men. However, there are at least a couple of reasons for pausing before trying to apply these findings to policy design. The first is that effective policy instruments may be difficult to identify. For instance, even income which is directly paid to women in a project may end up in the control of husbands. But secondly, and perhaps more importantly, there are significant methodological concerns regarding these empirical studies which warrant further assessment before translating their findings into policy actions (see following section on research implications).

3. Women's time allocation is an important and frequently overlooked determinant of their, and their children's, nutritional status. Kennedy and Bouis (1993) suggest that "the household that allocates more time to food preparation and child care could enjoy better nutrition because of reduced morbidity, than if it had earned extra income and spent more for food." Income generation strategies should not assume that women's time is in abundance, and should strive to conform to household labor needs – for instance, activities which allow women to earn income at home (e.g. cooking, tailoring, gardening) may be a possibility. The use of time-saving household technologies (e.g. mechanized grain processing mills) should also be encouraged. However, the purchase of such technologies may depend on who controls household income, as there is evidence that men are often unwilling to pay for them. The social constraints and nutritional benefits of such technologies need to be considered in policies affecting their availability.

4. Nutritional status depends, of course, on food intake, but in some cases, health conditions may be more constraining than food intakes on nutritional well-being. This was DeWaal's (1989) conclusion, for instance, in the case of the famine in Darfur, Sudan in 1984/85. *How* food consumption gains are realized may also determine whether, and to what extent, increased food consumption translates into improved nutritional status. For instance, technologies (e.g. irrigation) which increase food consumption, via increased agricultural productivity and farm

incomes, may have adverse health side effects which outweigh consumption benefits, resulting in diminished nutritional welfare. Another example may be distributions of food aid that encourage migration to feeding camps where there may be serious problems of infectious diseases. DeWaal (1989), in fact, goes so far as to conclude that food aid played no role in preventing starvation in Darfur's 1984 - 85 famine, and that if, instead, "Darfur had been provided with clean water, better sanitation, and measles vaccination, most or even all of the famine deaths could have been prevented." While this conclusion seems exaggerated, the point that we must not only look at providing food as a solution to malnutrition is a good one.

5. Food security researchers need to more carefully define the variables they are purporting to analyze (this paper suggests some definitions) and explain how these conceptual variables relate to the proxy indicators used to measure them. For instance, anthropometric data (measurements of body size) should **not** be (as they often are) *implicitly* equated with nutritional status (the level of nutrients available to body tissues). Also, empirical studies are fraught with problems of data unreliability and unobserved variables, the implications of which are frequently overlooked.

6. Furthermore, because careful descriptions of exactly how data were generated, and the problems involved, as well as access to the raw data itself, is missing from most of the literature, readers are forced to engage in a lot of "blind faith" in accepting conclusions which the authors derive. Reducing the necessity of blind faith acceptance of results could be encouraged by agencies which fund research by requiring, for instance, that reports be attached by summaries of the raw data used in order that analyses may be replicated.

7. Empirical findings suggesting that low income elasticities of calorie consumption at sample (or sub-sample) mean income levels imply that income generation is only weakly linked with food consumption, are often very misleading. The elasticity at the mean for *any* sample (or sub-sample), no matter how it is disaggregated, will inevitably underestimate the elasticity facing the poorest households in the sample. Two possible alternatives are to calculate elasticities for only those below a certain minimal food consumption standard, or to calculate the number of people which cross the line from calorie deficiency to calorie adequacy as a result of changes in real income. However, both of these alternatives face the very difficult problem of establishing what the requirement standards ought to be, as important inter-societal, intra-societal, and intra-individual differences exist in energy requirements.

8. The implications of male vs. female-controlled income for family members' food consumption and nutritional status needs more research before any substantial resources are devoted to this issue in the policy arena. More intrahousehold data would be useful, though expensive to collect. But less costly improvements in our understanding of intrahousehold allocation issues may be gained by reexamining the methods used in analyzing currently available data. In particular, when trying to show relationships between control of income and nutritional outcomes, more attention is needed on the issue of whether other factors not controlled for in the analyses may be responsible for any apparent correlations. For instance, regression models suggesting that women's control over income positively affects children's calorie intake has not always controlled for factors such as women's education level which could have positive affects

on both control over income and calorie intakes. If so, an apparent correlation between control over income and calorie consumption might reflect this heterogeneity in education rather than any causal relationship between the two. While there certainly may be cases where men do not properly care for the well-being of their children, we must wary of jumping too quickly to intuitively-suspect generalizations about parents' caring for their children.

REFERENCES

Abbi, Rita, Parul Christian, Sunder Gujral, and Tara Gopaldas. 1991. The Impact of Maternal Work Status on the Nutrition and Health Status of Children. *Food and Nutrition Bulletin* 13.1: 20-25. United Nations.

Abdi, O.A. 1992. Dietary Changes in Côte d'Ivoire and the Effect of the Value of Women's Time on Household Food Acquisition Behavior. Ph.D. dissertation, Cornell University.

Alderman, Harold. 1986. *The Effect of Price and Income Changes on the Acquisition of Food by Low-Income Households*. Washington, D.C.: International Food Policy Research Institute.

Alderman, Harold. 1992. *Incomes and Food Security in Ghana*. Working Paper No. 26. Washington, D.C.: Cornell Food and Nutrition Policy Program.

Alderman, Harold, and Paul Higgins. 1992. *Food and Nutritional Adequacy in Ghana*. Working Paper No. 27. Washington, D.C.: Cornell Food and Nutrition Policy Program.

Anand, Sudhir, and Martin Ravallion. 1993. Human Development in Poor Countries: On the Role of Private Incomes and Public Services. *The Journal of Economic Perspectives* 7.1: 133-50.

Behrman, Jere R. 1992. Intrahousehold Distribution and the Family. University of Pennsylvania. Unpublished draft.

Behrman, Jere R., and Anil Deolalikar. 1987. Will Developing Country Nutrition Improve with Income? A Case Study for Rural South India. *Journal of Political Economy* 95: 108-38.

Behrman, Jere R., and Barbara L. Wolfe. 1987. How Does Mother's Schooling Affect Family Health, Nutrition, Medical Care Usage, and Household Sanitation? *Journal of Econometrics* 36: 185-204.

Bennett, Lynn. 1988. The Role of Women in Income Production and Intra-Household Allocation of Resources as a Determinant of Child Nutrition and Health. *Food and Nutrition Bulletin* 10.3: 16-26. United Nations.

Bouis, Howarth E., and Lawrence J. Haddad. 1990. *Effects of Agricultural Commercialization on Land Tenure, Household Resource Allocation, and Nutrition in the Philippines*. Research Report No. 79. Washington, D.C.: International Food Policy Research Institute.

Chisvo, Munhamo, and T.S. Jayne. 1992. Is Grain Availability an Important Determinant of Variation of Nutritional Status among Children? Preliminary Evidence and Policy Implications from Zimbabwe's Communal Areas. In *Food Security Research in Southern*

Africa: Policy Implications, ed. J.B. Wyckoff and Mandivamba Rukuni. Harare, Zimbabwe: UZ/MSU Food Security Research in Southern Africa Project.

DeWaal, Alexander. 1989. *Famine That Kills*. Oxford: Clarendon Press.

Edmundson, W.C., and P.V. Sukhatme. 1990. Food and Work: Poverty and Hunger? *Economic Development and Cultural Change* 38.2: 263.

Frankenburger, Timothy R. 1992. *Indicators and Data Collection Methods for Assessing Household Food Security*. Unpublished draft.

Franklin, David L., and Marielouise W. Harrell. 1985. Resource Allocation Decisions in Low-Income Rural Households. *Food Policy* 10.2: 100-108.

Garcia, Marito, and Per Pinstrup-Andersen. 1987. *The Pilot Food Price Subsidy Scheme in the Philippines: Its Impact on Income, Food Consumption, and Nutritional Status*. Research Report No. 61. Washington, D.C.: International Food Policy Research Institute.

Garcia, Marito, and B. Senauer. 1992. Implications of Intrahousehold Analysis for the Assessment of a Food Subsidy Program. Paper prepared for International Food Policy Research Institute - World Bank Conference, Washington, D.C., February.

Gittelsohn, Joel. 1992. The Application of Anthropological Methods to the Study of Intrahousehold Resource Allocation. Unpublished draft.

Haaga, J.G. 1986. Negative Bias in Estimates of the Correlation Between Weight-for-Height and Height-for-Age. *Growth* 50.2: 147-54.

Haddad, Lawrence, and S.M. Ravi Kanbur. 1990. *Is There an Intra-Household Kuznets Curve? Some Evidence from the Philippines.* Discussion Paper No. 101. Coventry: Warwick University.

Haddad, Lawrence, Joan Sullivan, and Eileen Kennedy. 1992. *Identification and Evaluation of Alternative Indicators of Food and Nutrition Security: Some Conceptual Issues and an Analysis of Extant Data*. Washington, D.C.: International Food Policy Research Institute.

Harrell, Marielouise W., Culberto D. Parillon, and Elisabetta Politi. 1990. *Concept Paper for a Manual to Identify, Locate and Count Population Groups with Inadequate Food Security*. Washington, D.C.: U.S. Agency for International Development.

Harriss, Barbara. 1987. Nutrition and Agricultural Research. *Food Policy* 12.1: 29-34.

Harrison, Gail G. 1988. Nutritional Status Indicators. Report No. 4. Washington, D.C.: U.S. Department of Agriculture.

Hay, Roger. 1978. The Statistics of Hunger. *Food Policy*. 3.4: 243-55.

Hoddinott, John, and Lawrence Haddad. 1991. Household Expenditures, Child Anthropometric Status and the Intrahousehold Division of Income: Evidence from the Côte d'Ivoire. Discussion Paper #155. Princeton University Research Program in Development Studies.

Hussain, M.A. 1990. Nutrition Policy and the Urban Poor in Developing Countries. *Food Policy* 15.3: 186-92.

Jayne, T.S., and Munhamo Chisvo. 1991. Unravelling Zimbabwe's Food Insecurity Paradox: Implications for Grain Market Reform in Southern Africa. *Food Policy* 16.4: 319-29.

Jayne, T.S., and Lawrence Rubey. 1993. Maize Milling, Market Reform and Urban Food Security: The Case of Zimbabwe. *World Development* 21.6: 975-88.

Jayne, T.S., and Mandivamba Rukuni. 1993. Distributional Effects of Maize Self-Sufficiency in Zimbabwe: Implications for Pricing and Trade Policy. *Food Policy* 18.4: 334-41.

Kennedy, Eileen. 1989. *The Effects of Sugarcane Production on Food Security, Health, and Nutrition in Kenya: A Longitudinal Analysis*. Research Report No. 78. Washington, D.C.: International Food Policy Research Institute.

Kennedy, Eileen. 1991. *Effects of Gender of Head of Household on Women's and Children's Nutritional Status*. Washington, D.C.: International Food Policy Research Institute.

Kennedy, Eileen, and Howarth Bouis. 1993. Agriculture/Nutrition Linkages: Implications for Policy and Research. Washington, D.C.: International Food Policy Research Institute, May, 1993. Mimeo.

Kennedy, Eileen, and Bruce Cogill. 1987. *Income and Nutritional Effects of the Commercialization of Agriculture in Southwestern Kenya*. Research Report No. 63. Washington, D.C.: International Food Policy Research Institute.

Kennedy, Eileen, and Lawrence Haddad. 1992. Food Security and Nutrition, 1971-91: Lessons Learned and Future Priorities. *Food Policy* 17.1: 2-6.

Kennedy, Eileen, and Ruth Oniang'o. 1990. Health and Nutrition Effects of Sugar Cane Production in Southwestern Kenya. *Food and Nutrition Bulletin* 12.4: 261-267. United Nations.

Kennedy, Eileen, and Ellen Payongayong. 1992a. *Patterns of Macronutrient and Micronutrient Consumption and Implications for Monitoring and Evaluation*. Washington, D.C.: International Food Policy Research Institute.

Kennedy, Eileen, and Ellen Payongayong. 1992b. *Inventory of Food and Nutrition Monitoring Systems*. Washington, D.C.: International Food Policy Research Institute.

Lutter, C.K., J-P. Habicht, J.A. Rivera, and R. Martorell. 1992. The Relationship Between Energy Intake and Diarrhoeal Disease in Their Effects on Child Growth: Biological Model, Evidence, and Implications for Public Health Policy. *Food and Nutrition Bulletin* 14.1: 36-42. United Nations.

Mason, John, Marito Garcia, Janice Mitchell, Karen Test, Clarence Henderson, and Hamid Tabatabai. 1985. Nutritional Considerations in Project Planning. *Food Policy* 10.2: 109-22.

McGuire, Judith, and Barry M. Popkin. 1989. Beating the Zero-Sum Game: Women and Nutrition in the Third World, Part 1. *Food and Nutrition Bulletin* 11.4: 38-63. United Nations.

Pelletier, D.L., J.D. Haas, J.B. Mason, and M. Bondad. 1985. *A Comparison of Stunting and Wasting Indicators of Malnutrition in Philippine School Children*. CNSP Working Paper No. 21. Ithaca, NY: Cornell University.

Pinstrup-Andersen, Per. 1987. Food Prices and the Poor in Developing Countries. In *Food Policy – Integrating Supply, Distribution and Consumption*, ed. J.P. Gittinger, J. Leslie, and C. Hoisington. Baltimore, MD: Johns Hopkins University Press.

Pitt, Mark M., Mark R. Rosenzweig, and Md. Nazmul Hassan. 1990. Productivity, Health, and Inequality in the Intrahousehold Distribution of Food in Low-Income Countries. *American Economic Review* 80.5: 1139-56.

Poleman, Thomas T. 1983. World Hunger: Extent, Causes, and Cures. In *The Role of Markets in the World Food Economy*, ed. D. Gale Johnson and G. Edward Schuh. Boulder CO: Westview Press.

Rabiee, Fatimeh, and Catherine Geissler. 1992. The Impact of Maternal Workload on Child Nutrition in Rural Iran. *Food and Nutrition Bulletin* 14.1: 43-48. United Nations.

Randolph, Susan, Richard D. Ely, Linsay H. Allen, Adolfo Chavez, and Gretel H. Pelto. 1991. The Assessment of Calorie Adequacy. *Food and Nutrition Bulletin* 13.1: 3-6. United Nations.

Ravallion, Martin. 1990. Income Effects on Nutrition. *Economic Development and Cultural Change* 38.3: 489-515.

Rogers, Beatrice Lorge, and Melanee Lowdermilk. 1991. Price Policy and Food Consumption in Urban Mali. *Food Policy* 16.6: 461-73.

Rogers, Beatrice Lorge, and Nadia Youssef. 1988. The Importance of Women's Involvement in Economic Activities in the Improvement of Child Nutrition and Health. *Food and Nutrition Bulletin* 10.3: 33-41. United Nations.

Rubin, Deborah. 1990. Women's Work and Children's Nutrition in Southwestern Kenya. *Food and Nutrition Bulletin* 12.4: 268-72. United Nations.

Sarma, J.S., and Vasant P. Gandhi. 1990. *Production and Consumption of Food Grains in India: Implications of Accelerated Economic Growth and Poverty Alleviation.* Research Report No. 81. Washington, D.C.: International Food Policy Research Institute.

Schiff, Maurice, and Alberto Valdes. 1990. Poverty, Food Intake, and Malnutrition: Implications for Food Security in Developing Countries. *American Journal of Agricultural Economics* 72.5: 1318-22.

Schiff, Maurice, and Alberto Valdes. 1990. *The Link Between Poverty and Malnutrition: A Household Theoretic Approach.* WPS 536. Washington, D.C.: World Bank.

Schiff, Maurice, and Alberto Valdes. 1990. Nutrition: Alternative Definitions and Policy Implications. *Economic Development and Cultural Change* 38.2: 281-92.

Schnepf, Randall D. 1992. *Nutritional Status of Households: Survey Evidence on the Role of Household Consumption Behavior*. Working Paper 23. Cornell Food and Nutrition Policy Program.

Sen, Amartya. 1981. *Poverty and Famines*. Oxford: Clarendon Press.

Senauer, Benjamin. 1990. Household Behavior and Nutrition in Developing Countries. *Food Policy* 15.5: 408-17.

Srinivasan, T.N. 1983. Hunger: Defining It, Estimating Its Global Incidence, and Alleviating It. In *The Role of Markets in the World Food Economy*, ed. D. Gale Johnson and G. Edward Schuh. Boulder, CO: Westview Press.

Staatz, J.M., V.C. D'Agostino, and S. Sundberg. 1990. Measuring Food Security in Africa: Conceptual, Empirical, and Policy Issues. *American Journal of Agricultural Economics* 72.5: 1311-17.

Strauss, John. 1984. Joint Determination of Food Consumption and Production in Rural Sierra Leone. *Journal of Development Economics* 14: 77-103.

Strauss, John. 1985. *The Impact of Improved Nutrition in Labor Productivity and Human Resource Development: An Economic Perspective*. Economic Growth Center, Discussion Paper No. 494. New Haven, CT: Yale University Press.

Strauss, John. 1990. Households, Communities, and Preschool Children's Nutrition Outcomes: Evidence from Rural Côte d'Ivoire. *Economic Development and Cultural Change* 38.2: 231-62.

Strauss, John. 1993. Personal communication.

Strauss, John, and Kalpana Mehra. 1990. *Child Anthropometry in Côte d'Ivoire: Estimates from Two Surveys, 1985 and 1986*. Living Standards Measurement Studies Working Paper 51.

Svedberg, Peter. 1990. Undernutrition in Sub-Saharan Africa: Is There a Gender Bias? *Journal of Development Studies* 26.3: 469-86.

Thomas, Duncan. 1992. The Distribution of Income and Expenditure within the Household. Yale University. Unpublished draft.

Tschirley, David L., and Michael T. Weber. 1994. Food Security Strategies under Extremely Adverse Conditions: The Determinants of Household Income and Consumption in Rural Mozambique. *World Development* 22.2: 159-73.

Tucker, Katherine, David Pelletier, Kathleen Rasmussen, J.P. Habicht, Per Pinstrup-Andersen, and Frederick Roche. 1989. *Advances in Nutritional Surveillance: The Cornell Nutritional Surveillance Program 1981 - 1987*. Ithaca, NY: Cornell Food and Nutrition Policy Program.

von Braun, Joachim, John McComb, Ben K. Fred-Mensah, and Rajul Pandya-Lorch. 1993. *Urban Food Security and Malnutrition in Developing Countries: Trends, Policies, and Research Implications.* Washington, D.C.: International Food Policy Research Institute.

von Braun, Joachim, Hartwig de Haen, and Juergen Blanken. 1991. *Commercialization of Agriculture under Population Pressure: Effects on Production, Consumption, and Nutrition in Rwanda*. Research Report No. 85. Washington, D.C.: International Food Policy Research Institute.

von Braun, Joachim, Detlev Puetz, and Patrick Webb. 1989. *Irrigation Technology and Commercialization of Rice in the Gambia: Effects on Income and Nutrition*. Research Report No 75. Washington, D.C.: International Food Policy Research Institute.

Wandel, Margareta, and Gerd Holmboe-Ottesen. 1992. Maternal Work, Child Feeding, and Nutrition in Rural Tanzania. *Food and Nutrition Bulletin* 14.1: 49-54. United Nations.

Weber, Michael T., John M. Staatz, John S. Holtzman, Eric W. Crawford, and Richard H. Bernsten. 1988. Informing Food Security Decisions in Africa: Empirical Analysis and Policy Dialogue. *American Journal of Agricultural Economics* 70.5: 1044-52.

Wise, Victoria. 1992. Gender Issues in Food Security Research in the Sahel. Unpublished draft.

Wolfe, B. and J. Behrman. 1983. Is Income Overrated in Determining Adequate Nutrition? *Economic Development and Cultural Change* 31.3: 525-50.