DISCUSSION PAPER NO. 22

ALTERNATIVE APPROACHES TO LOCATING THE FOOD INSECURE: QUALITATIVE AND QUANTITATIVE EVIDENCE FROM SOUTH INDIA

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January 1997

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ACKNOWLEDGMENTS

The Alternative Indicators Study was a collaborative project between the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT); the International Food Policy Research Institute (IFPRI); Andhra Pradesh Agricultural University (APAU), Hyderabad, India; and the National Institute of Nutrition (NIN), Hyderabad, India. We would like to acknowledge the following individuals for their assistance with this work:

Data Collection/Entry/Editing (ICRISAT):

T.V.N. Anuradha, V. Sujatha, D. Vijayalakshmi, P. Tanuja, N. Jyothi, N. Leena, K. Anita, T. Vasantha, Neeta Potdar, V. Sujatha, G.D. Nagashewar Rao, Y. Mohan Rao, V. K. Chopde, V. B. Ladole, V. Bhasker Rao, Murthy, K. Radha Vani, B. Seshanjini, H. Hariharan, Stanford Waits, M. Baig

Computer Analysis:

Kathleen Merchant (UNLV), A. Narasimha Rao (ICRISAT), Joshua Rozen (MPR), and Ellen Payongayong (IFPRI)

Editing and Writing:

Christine Peña (World Bank), Lynn Brown (IFPRI), Eugenie Feakin (ICRISAT)

Computer Support:

Nancy Walczak, Dave Bruton, Mary Snyder, and Yin Leong (IFPRI)

Administrative Support:

V.N. Krishnan, V.S. Swaminatham (ICRISAT), Lynette Aspillera, Tina Abad, Ginette Mignot, Julia Addae-Mintah, Michelle Mendez, Jay Willis, Andy Orlin (IFPRI), Bruce Cogill (ISTI)

Intellectual Support:

Margaret Bentley (Johns Hopkins University), Eunyong Chung (USAID), Bruce Cogill (ISTI), Frances Davidson (USAID), Dr. P. Yasoda Devi, Ed Frongillo (Cornell University), Dr. P. Geervani, Eileen Kennedy (USDA), Lynnda Kiess (World Bank), Dr. K. Nair, Dr. G.N.V. Ramana (NIN), Dr. K. Chittema Rao (APAU), Dr. N. Prahlad Rao, Dr. Vinodini Reddy (NIN), Jay Ross (AED), Andrew Swiderski (USAID), Elizabeth Tolley, and Kathleen Tucker (Tufts University).

EXECUTIVE SUMMARY

This paper reports on two methods used for identifying alternative indicators of chronic and acute food insecurity. A need for alternative indicators exists since many of the "benchmark" or "gold standard" indicators (such as household income or dietary intake) are too cumbersome to be of practical use in food aid targeting. The ideal alternative indicator should be statistically reliable, yet straightforward to collect and analyze.

The study uses data collected in four villages in the Indian Semi-Arid Tropics to illustrate two methods for identifying the alternative indicators. A qualitative methodology included ethnographic case studies of at-risk households, participatory mapping of vulnerable households within a community, food charts, and seasonality charts. The quantitative methods included both economic and nutrition surveys. The data were collected over three rounds in 1992-93 from 324 households in south-central India.

For the qualitative work, we used both the villagers' perceptions of food insecurity as well as the ethnographers' observations to generate a list of indicators for these areas. Triangulation among the various qualitative methods was used to validate the indicators suggested. For the quantitative study, we used statistical methods to test the strength of association between each indicator and six benchmark measurements of food security. The benchmark measurements were derived from dietary recall, anthropometric, and blood data. The dietary data were used to generate a benchmark for chronic and acute households' food insecurity. The anthropometric data were used to construct benchmarks of chronic and acute preschooler food insecurity. Finally, serum measures of vitamin A and iron adequacy were used to generate benchmarks of household micronutrient insecurity.

We tested a core set of alternative indicators against each of these benchmarks. The majority of the alternative indicators were drawn from a review of the food security literature as well our own qualitative work in the study sites. Other indicators were included as they represent information that is typically available in secondary data sets collected by governments and research institutions.

For each benchmark, the quantitative tests involved two steps. We first "screened" the large set of core indicators for their statistical association with the appropriate benchmark. We then used a hypothesis-testing framework to test the relationship between the "screened" indicators and the benchmark of interest. The strength of the association was assessed using two criteria: a Bonferroni-corrected chi-square statistic and an unadjusted chi-square statistic.

Indicators that proved successful in the quantitative analysis were used in targeting simulations to explore the savings associated with using indicators to target food aid distributions. The simulations assumed a certain set of program characteristics. Given that program parameters will vary, these simulations are illustrative of the *potential* benefits to targeting. The results indicate that modest but significant associations between a targeting indicator and the benchmark can provide savings in terms of program costs. In some cases, the program savings can be quite substantial. We note, however, that program costs are not the only cost-related issue at stake; rather, data collection costs and the social and financial costs of making targeting "mistakes" must also be taken into account. A full accounting of these costs can render an alternative indicator less efficient than a benchmark indicator.

Assuming that a benchmark indicator is either too expensive or infeasible to use, are qualitative or quantitative methods more appropriate for choosing an alternative indicator? Our experience indicates that the choice of method depends on the type of human and financial resources available to an organization, the speed with which decisions must be made, and the types of secondary data already available. For example, targeting at the household and individual levels is likely to be a component of an NGO's programming activities. Given that (1) NGOs often work intensively in a limited number of communities and that (2) financial and human resources are generally limited, the qualitative method appears to be the most viable option for these organizations.

On the other hand, a combination of qualitative and quantitative methods might be more appropriate for organizations that plan to carry out more centralized forms of targeting (such as governments, large-scale NGOs, or international organizations.) The quantitative methods, however, require large sample sizes for statistical testing as well as personnel and equipment to collect and analyze these data. As such, use of these methods is limited to institutions with the requisite financial, human, and computing resources.

Clearly, there are advantages and disadvantages to each method chosen. The qualitative methods require less time for analysis, but require staff with special talents for interpreting qualitative information. In addition, qualitative results are not generalizable and are thus location-specific. By contrast, the quantitative method requires staff with statistical skills as well as large databases that increase the probability of sufficient power for tests of statistical association. The results from quantitative studies are more generalizable to similar populations, but can be puzzling if little is known about the program areas. As such, qualitative information is useful for indicator identification and evaluation, even when a quantitative approach is taken.

Finally, we must underscore the difference between using a qualitative method and a participatory one. At the outset, we planned to use participatory methods as we thought they would be more respectful and empowering to the communities we studied. However, we found that despite our best intentions, the research-based participatory methods were no more empowering for the villagers than our survey methods. This is more a testament to the objective of pursuing a predetermined research agenda rather than a failure of participatory methods per se. Our experience leads us to believe that qualitative techniques are truly participatory when employed in action-orientation interventions.

1. INTRODUCTION

THE NEED FOR ALTERNATIVE INDICATORS OF FOOD SECURITY FOR TARGETING

Targeting scarce resources toward the food insecure lies among the many objectives of food-related information systems. Although targeting is not a new tool, its use has become even more relevant in today's era of ever-shrinking aid budgets. To be successful, however, a viable targeting system requires indicators that are valid and reliable for identifying at-risk groups and still straightforward and inexpensive to use. In spite of this obvious need, a recent survey of food and nutrition policymakers in developing countries found many of the recommended indicators difficult to incorporate into ongoing information and targeting systems (Kennedy and Payongayong 1991). Too often, indicators are laborious and expensive to collect, difficult to analyze and interpret, and of limited use in targeting-related activities.

A need therefore exists for food security indicators that are simple to derive and simple to use. Recent empirical analyses by Haddad, Sullivan, and Kennedy (1992) suggest that relatively simple indicators can perform well in locating the food insecure. Their work suggested that indicators such as number of unique foods consumed, region, dependency ratio, household size, rooms per capita, incidence of illness, vaccination status, age at weaning, drinking water and sanitation facilities—all coded with only two or three different values—were able, either singly or in combination, to identify food-insecure households and preschoolers.

This work continues the work by Haddad, Sullivan, and Kennedy (1992) by exploring the methodological issues related to the identification and validation of alternative indicators for targeting food security programs. Two distinct methods of indicator development are considered: qualitative methods that rely on indigenous knowledge and quantitative methods that rely on conceptual models derived from theory.

THE NEED FOR ALTERNATIVE INDICATORS IN INDIA

Fortunately, famines in India are a "nightmare of the past" (Gopalan 1992). This has been due to: food production that has kept up with population increases, government buffer stocks of grain which have stabilized food grain prices, democracy and a free press to give the rural poor a voice, the existence of relatively efficient inter-regional grain markets, the availability of informal consumption credit, and a set of explicit famine-relief policies such as rural public works programs (Drèze 1988; Bidinger et al. 1990).

Given the successful prevention of famine in India, is there a need for improved targeting of food security and nutrition programs? There are at least two reasons why the search for better targeting methods is crucial. First, improvements in aggregate food availability at the national and regional levels have not eliminated chronic and often severe food insecurity throughout

much of the country. Child malnutrition rates in India, for example, continue to cause alarm. According to the UNDP's 1994 Human Development Report, 63 percent of children under five in India were underweight in 1990—the highest rate of any of the 127 developing countries listed (UNDP 1994).

Second, current programs designed to address food insecurity come at the cost of scarce resources that have alternative uses. For example, India's Title II food aid program has ranked as the world's largest non-emergency food program since its inception in 1954. In recent years, the value of Title II food aid has reached approximately US$100 million annually. There is a widespread feeling that current levels of food security in India could be achieved with less strain on public expenditures if policies were better targeted to the undernourished (Government of India 1990; Ravallion and Subbarao 1992; Jha 1992; Dev, Suryanarayana, and Parikh 1992; Bapna 1991; Harriss 1991).

Food aid programs in India are diverse, but center on providing aid to food-insecure preschoolers, women, and households (USAID 1994). Resources are currently targeted in a number of different ways. Under the Integrated Child Development Scheme (ICDS), health workers are asked to use anthropometry to screen prospective children and pregnant women for food supplements and child development programs (NIPCCD 1989). The World Food Programme currently runs a "self-targeting" Food-For-Work program, implicitly assuming that only food-insecure households will avail of this work scheme. However, undercoverage is a concern for many of these programs since not enough needy households or individuals receive benefits (Kennedy and Slack 1993). Program leakage can be high in some areas, with benefits often accruing to those who would not otherwise be considered needy (NIPCCD 1989). Interviews in our study villages indicated a frustration among *aganwadi* workers in their inability to target resources better (Vasantha 1993).

Clearly, resources mobilized to combat food insecurity—whether from the Government of India or in the form of donor food aid—will be much more effective if they can be targeted to the most food insecure. But who are the food insecure and where are they? Is it possible to identify these at-risk groups in a way that is consistent with local capacity for targeting and implementing these programs?

RESEARCH OBJECTIVES

The objective of this study is to explore two methods for selecting "alternative" indicators for targeting food security programs. In keeping with the message from policymakers and practitioners around the world, the alternative indicators should be simple to develop, collect, and use.

Specific study objectives include the development of relatively simple methods to:

1. Identify a set of candidate alternative indicators. This set of candidates will include (1)"generic" indicators that are derived from a general conceptual framework of food security and are not unique to a particular setting as well as (2) "location-specific" indicators that are derived from qualitative field methods in the study area.
2. Identify appropriate "targeting" indicators by testing the statistical association of the candidate indicators with more direct, benchmark measures of food security.
3. Assess the relative performance of each of the targeting indicators for improving the efficiency of food security and nutrition-related programs. Increased efficiency is defined in terms of reducing program costs and maximizing the social benefit associated with programs.

OUTLINE OF REPORT

The study focuses on four villages in two Indian States: Maharashtra and Andhra Pradesh. Alternative and benchmark indicators of household and individual food security were collected using survey, ethnographic, and participatory methods during three rounds between August 1992 and September 1993.

Qualitative methods are used to identify locally-determined indicators of food insecurity. These methods include participatory rural appraisal exercises and traditional ethnographic case studies. In addition to the qualitative studies, a quantitative approach is presented for identifying indicators. For this method, the alternative indicators are compared to a set of benchmark indicators that are presumed to represent the true food security situation. The benchmark indicators are based on caloric adequacy measures, anthropometry, and biochemical serum determinations.

The performance of the alternative targeting indicators are judged by the strength of their association with the benchmark indicators as well as their cost-effectiveness. Two-by-two contingency tables are used to determine whether the proportion of cases (households or individuals) with a certain indicator characteristic are more likely to be food insecure than those without the same characteristic (Snedecor and Cochran 1989). Various targeting simulations are also undertaken to demonstrate the potential resources saved through targeting with the indicators identified.

2. LITERATURE REVIEW

FOOD AND NUTRITION MONITORING IN INDIA[1]

A large number of nutritional assessment studies were undertaken in India over the period 1918-1972. Their coverage was limited, however, and they were not undertaken on a regular basis. This lack of comprehensive repeated assessments led the Indian Council of Medical Research to set up the National Nutrition Monitoring Bureau (NNMB) in 1972. The NNMB's mission is to

- continuously collect and process information on dietary intakes and nutritional status of representative segments of the Indian population, using standardized procedures and techniques, and
- undertake periodic evaluation of ongoing national nutrition programs.

A recent evaluation of the NNMB's activities (Rao, Sastry, and Rao 1987) found that current operations were hampered by lack of internal coordination and excessive administrative bureaucracy. As part of a series of efforts to improve the NNMB's efforts, the National Institute of Nutrition (NIN) initiated a project to develop a nutritional surveillance model that used simple and sensitive indicators that would be useful to both macro and micro planning. The project has been undertaken in Andhra Pradesh, and is designed to

1. Use primary and secondary data sources to illuminate the relationship between basic needs indicators, economic, environmental, and agricultural factors, and food consumption and nutritional status;
2. Develop a set of simple, quick to collect, and cost-effective indicators to form the core of a nutrition surveillance system; and
3. Develop both the computer software and hardware necessary to implement the monitoring system.

The need for indicators with such characteristics has been identified by the NIN as of paramount importance. The research undertaken as part of this study, to identify effective indicators that are simple to collect and use in targeting ongoing nutrition programs, is a timely and innovative complement to the efforts planned by NIN.

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[1] Appendix 7.1 provides a more complete review of nutrition monitoring systems in India.

CONCEPTUAL FRAMEWORK FOR UNDERSTANDING FOOD SECURITY

For this work, we adopt a commonly accepted definition of food security:

> *When all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life* (USAID 1992).

By this definition, food security is a broad and complex concept that is determined by agro-physical, socioeconomic, and biological factors (Campbell 1991; von Braun et al. 1992). Furthermore, food security is defined by a triad of concepts: food availability, food access, and food utilization. By implication, the "food insecure" have lost, or *are at risk of losing*, availability and access to food, or the ability to utilize it. Several researchers have included this concept of *vulnerability* in their definitions of food security (Watts and Bohle 1993; Radimer, Olson, and Campbell 1990; Kendall, Olson, and Frongillo 1995). Few, however, have broadened the notion of food security to include elements of *social acceptability* (Radimer, Olson, and Campbell 1990; Kendall, Olson, and Frongillo 1995) and *sustainability* (Chambers 1991).

It is also important to recognize the temporal dimensions of the food security concept. *Chronic food insecurity* is characterized by a persistent inability to attain food access over the long term. *Acute food insecurity* is characterized by abrupt declines in food security status over a relatively short period of time. These short-term declines in food security status may occur on a fairly regular basis as the result of seasonal changes in food access in a given area. They may also be associated with less frequent, but more acute, declines in food access, as in the case of famine.

The factors that influence the food security status of households and individuals may be quite diverse. The United States Agency for International Development (USAID) identifies a range of important issues that lead to the food insecurity of households and individuals in the developing world. These include, among others; chronic poverty, rapid population growth, declining per capita food output, poor infrastructure, ecological constraints, limited arable land, disease, poor water and sanitation, inadequate nutritional knowledge, civil war, and ethnic conflicts (USAID 1995).

Figure 1 summarizes the diverse determinants of food security status into a general conceptual framework. In particular, the framework highlights the hypothesized causal relationships between the various elements of food availability, access, and utilization. It therefore focuses on the links between the resources commanded by the household, levels of farm and off-farm production, household income, household and individual consumption, and individual nutrition. This configuration suggests that adequate food availability is a necessary, although not sufficient, condition to achieve adequate food access. Food access, in turn, is necessary, but not sufficient, for adequate food utilization.

FOOD SECURITY INDICATORS

Figure 1 also provides a brief list of indicators associated with each link in the food security causal chain. These indicators are derived from the food security literature. This literature spans a wide range of disciplines—including anthropology, nutrition, sociology, geography, public health, epidemiology, and economics. The recent literature is reviewed in Haddad, Sullivan, and Kennedy (1992) and Maxwell and Frankenberger (1992).

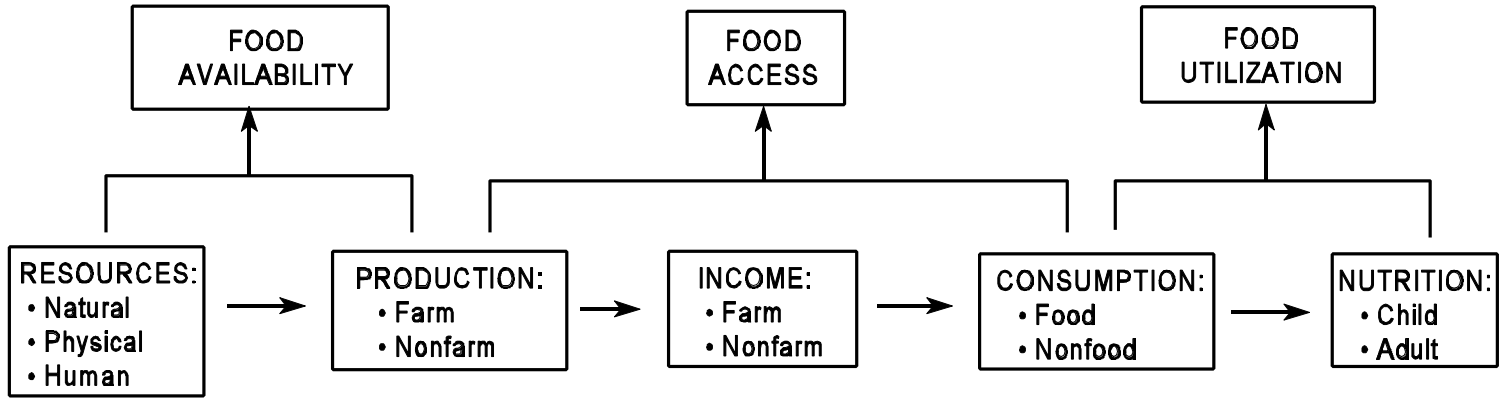
The indicators described in Figure 1 are somewhat "generic," as they are defined by theory rather than by a specific set of empirical observations. As a result, it is expected that these indicators may be obtained in a fairly consistent fashion across locations and socioeconomic contexts. This list of indicators is intended to be suggestive, however, not exhaustive. Undoubtedly, there are other indicators suggested by food security theory that have been excluded. Furthermore, there are sure to be additional indicators of food security that are unique to a particular setting. Such indicators may only be identified through fieldwork in each location.

The conceptual framework is useful as a starting point for identifying food security indicators for targeting. The precise measures chosen as targeting indicators will depend on the particular aspect of food access that the intervention is designed to address. Consider, for example, a program focused on improving food access. Figure 1 suggests that targeting criteria should be chosen from measures that represent household production, income, or consumption. Similarly, efforts to improve food utilization would likely employ indicators of consumption and nutritional status as targeting criteria.

When direct measures of these targeting criteria are difficult or expensive to obtain, the conceptual framework may also assist in the identification and prioritization of alternative indicators to test as proxies. In general, indicators in close proximity to one another along the causal chain described in Figure 1 are likely to be more strongly associated than those that are more distantly located.[2] Indicators of frequency of consumption of particular foods, for example, are expected to be relatively strongly associated with indicators derived from dietary intake data, compared to indicators in the income category. Similarly, indicators of consumption are expected to be more strongly associated with indicators of nutritional status

[2] There are likely to be a number of exceptions to this general statement of relationships. As an example of one exception, although not in close proximity along the causal chain defined in Figure 1, demographic indicators such as education levels and household size are thought to be strongly associated with nutritional status outcomes.

Figure 1 Food security conceptual framework and "generic" indicator categories



"GENERIC" INDICATOR CATEGORIES

RESOURCES
Natural:
Rainfall levels/stability
Soil quality
Water availability
Forest resource access

Physical:
Livestock ownership
Infrastructure access
Farm implement ownership
Land ownership/access
Other physical assets

Human:
Gender of household head
Dependency ratio
Education/literacy levels
Household size
Age of household head

PRODUCTION
Total area cultivated
Irrigated area
Area in fallow
Access to/use of inputs
Number of cropping seasons
Crop diversity
Crop yields
Food production
Cash crop production

INCOME
Total income
Crop income
Livestock income
Wage income
Self-employment income
Producer prices
Market/road access

CONSUMPTION
Total expenditure
Food expenditure
Nonfood expenditure
Consumer prices
Dietary intake
Food frequencies

NUTRITION
Anthropometry
Serum micronutrient levels
Morbidity
Mortality
Fertility
Access to health services
Access to clean water source
Access to adequate sanitation

Source: Adapted from Webb, Richardson, and von Braun (1993).

than indicators of production. This suggests a hierarchy for testing alternative indicators when resources are limited: indicators that lie close to the direct measure should be tested first, as they are most likely to have a strong association with the benchmark. There will, of course, be exceptions to this statement.[3] Yet, in general, such indicators are more likely to identify the intended segment of the population than those selected from more distant points along the causal chain.

INDICATORS FROM INDIA

A review of the India literature reveals a specific set of indicators that are thought to capture important aspects of food security status. Correlates of preschooler nutrition status include low (scheduled) caste, no land (or very little), poor nutrition knowledge, mother forced to work outside the home, young age of mother at marriage, later-born child, being a girl-child, and recent diarrheal infection (Chung et al. 1996, Appendix 2).

3. METHODOLOGICAL FRAMEWORK

INDICATORS OF CHRONIC AND ACUTE FOOD INSECURITY

This chapter presents a method for identifying food security indicators at the individual and household levels. Alternative indicators are developed for both *chronic* and *acute* food insecurity. For this study, area indicators of chronic food insecurity are necessary because many of the households are persistently food insecure. Indicators of acute food security are also necessary, because some households are expected to exhibit seasonality in food production, income generation, and morbidity rates. Consequently, we focus on identifying indicators that tell us if a household is chronically food insecure and indicators that predict acute, season-to-season declines in household food security. It is important to note that households can simultaneously exhibit chronic and acute food insecurity.

IDENTIFYING CANDIDATE INDICATORS

Two types of candidate indicators are proposed. Candidate indicators are termed *generic* indicators if (1) they can be collected in a number of different settings and (2) they are derived from a well-defined conceptual framework of food security. Although the candidate indicators are postulated to operate across a wide range of possible settings, their interpretation and relative importance in describing a particular aspect of food security is likely to be context-specific. The actual usefulness of any generic indicator must therefore be tested in the context of each

[3] With exceptions due to confounding, measurement error, etc.

program. Examples of generic indicators are the household dependency ratio and the incidence of preschooler illness in a household.

Fieldwork may also reveal a set of indicators that we call *location-specific*. Location-specific indicators typically only carry meaning within a particular study area due to unique agroclimatic, cultural, or socioeconomic factors. Types of food grown that are unique to an area, local seasonal behavioral patterns, or cultural feeding practices may define location-specific indicators. In India, an example of a unique indicator might be "caste." Location-specific indicators can only be identified from a detailed understanding of local conditions. This understanding is best obtained by using qualitative data collection methods.

In this study, we use both qualitative and quantitative methods to identify and test alternative targeting indicators. The generic indicators are identified from the food security literature and tested using statistical methods. The location-specific indicators are suggested by information generated using qualitative methods.

THE NEED FOR A BENCHMARK

The search for effective alternative indicators relies upon comparisons of the candidate indicators to a benchmark or "gold standard" measure of food security. This comparison however, assumes that the benchmark indicator is itself a direct and accurate measurement of "true" food security status.

Given that food security is a multifaceted concept, there is no one indicator that encompasses all dimensions of availability, access, and utilization. However, from a practical perspective, a multifaceted food security indicator may not be what is needed. Rather, most food security programs are designed to address a particular element of the food security problem. As such, the choice of a benchmark indicator for selecting alternative targeting indicators should depend on the objectives of each program.

Assume, for example, that chronically low levels of food access is the food security concern that requires intervention. Under these conditions, candidate alternative indicators should be tested against a benchmark indicator of chronic access. A long-term measure of per capita food expenditure or energy intake are possible examples of appropriate benchmark indicators. Similarly, if preschooler malnutrition is the critical food security concern, then the benchmark measure might be some measure of child anthropometry. In the area of nutrition in particular, there is a considerable body of expertise in identifying appropriate indicators for various program types and information purposes (see, for example, Habicht and Pelletier 1990).

For the purposes of this study, alternative targeting indicators will be derived for six specific dimensions of food insecurity: chronic and acute household-level food insecurity, chronic and acute preschooler food insecurity, and vitamin A and iron deficiency. Table 1 summarizes the benchmark measures that will be used to evaluate a wide range of candidate alternative indicators in this study. The chosen benchmark of household food security is

household energy adequacy. In order to increase the association between this indicator and the true, but unobserved, measure of adequate food intake (our definition of household food security), we (1) undertake two repeated 24-hour dietary recall surveys within each season, (2) collect three rounds of 24-hour dietary recall data in three seasons, and (3) construct calorie requirements based on age, weight, sex, physiological status, and a three-scale classification of activity patterns.

The analysis of alternative indicators for preschooler food security use anthropometric measures as benchmarks (height-for-age for chronic food insecurity and weight-for-height for acute food insecurity). The benchmark indicators of vitamin A and iron insecurity are also based on biochemical indicators of nutritional status. Serum vitamin A and hemoglobin serve as benchmarks for these analyses.

QUANTITATIVE MEASURES OF ASSOCIATION

There are a number of methods to evaluate the association between benchmark and alternative indicators: correlation coefficients (both continuous and rank), factor analysis, cluster analysis, and regression analysis, among others. Each of these methods has been reviewed for its usefulness to this project and has been found to present significant limitations for the purposes outlined above (Haddad, Sullivan, and Kennedy 1992; Haddad, Chung, and Yasoda Devi 1993).

Aside from these methods, two other methods merit special discussion: contingency tables and receiver operating characteristic curves (ROC analysis). Contingency tables are frequently used in the nutrition epidemiology literature as a measure of association. This method (also reviewed in Haddad, Sullivan, and Kennedy 1992) is summarized in Table 2 and described in detail in Tucker et al. (1989).

In a contingency table, observations are categorized according to two dichotomous criteria, the benchmark indicator and the alternative indicator.[4] Statistical tests may be used to indicate whether the alternative indicator is significantly associated with the benchmark indicator. Indicators that show a significant association with the benchmark can be rated according to two criteria: sensitivity and specificity. Sensitivity is defined as the proportion of truly food-insecure individuals that is identified by the alternative indicator (i.e., the probability

[4] To make a contingency table, observations are categorized by two dichotomous criteria. If the two variables are originally continuous variables, a "cutoff point" must first be chosen to transform the continuous variable into a dichotomous variable. The cutoff point determines whether an observation is qualified as a "1" or a "0."

Table 1 Definition of benchmark indicators of food insecurity used in the quantitative assessment of alternative indicators

	Indicator of Chronic Conditions	Indicator of Acute Conditions
Household-level food insecurity	Households with less than 70 percent of caloric adequacy in four of six visits	Households dropping below 70 percent caloric adequacy between survey rounds 2 and 3, or those already below 70 percent adequacy experiencing a further drop of 10 percent or more
Preschooler-level food insecurity	Children five years of age and under with height-for-age Z-scores less than -3.00	Children under five years of age among the 30 percent with the most acute decline in weight-for-height Z-score between rounds 2 and 3
	Indicator of Vitamin A Deficiency	**Indicator of Iron Deficiency**
Micronutrient deficiency	Households containing at least one woman or child with serum vitamin A levels less than 20 µg/dl	Households with at least one woman or child with hemoglobin levels less than WHO cutoffs

Table 2 Relationships between true food insecurity, as determined by the benchmark and food insecurity measured by the alternative

		"True" Benchmark Measure of Food Security	
		Yes	No
Alternative Measure of Food Security	Yes	True-Positive (a)	False-Positive (b)
	No	False-Negative (c)	True-Negative (d)

Sensitivity = True-Positive/(True-Positive + False-Negative) or a / a+c

Specificity = True-Negative/(False-Positive + True-Negative) or d / b+d

Positive Predictive Value = True-Positive/(True-Positive + False-Positive) or a / a+b

Source: Habicht, Meyers, and Brownie (1982).

of a true positive). Specificity refers to the proportion of truly food-secure individuals that is correctly identified by the indicator (i.e., the probability of a true negative). If an indicator is to be effective at identifying the food insecure, it is important for both sensitivity and specificity to be high. As such, it is common in the nutrition literature to sum the sensitivity and specificity.[5]

Note, however, that the sensitivity-specificity table assumes that an appropriate cutoff point has been chosen for the alternative indicator. Research in the surveillance literature has shown that the performance of an indicator can be highly dependent on the chosen cutoff. Indicators can be compared, however, across a range of cutoffs using ROC analysis. This method is a generalization of the two-by-two sensitivity-specificity analysis described above. It has been used in psychology (Szucko and Kleinmuntz 1981), medicine (Swets 1979), and

[5] There are diagnostic instances when sensitivity and specificity are not weighted equally. In this case, researchers might chose an indicator for its performance on sensitivity or specificity.

nutrition epidemiology (Brownie, Habicht, and Cogill 1986; Ruel, Rivera, and Habicht 1995; Ross et al. 1995), among other fields.

From a technical perspective, the optimal cutoff point exists at the point where the sum of sensitivity and specificity are maximized.[6] In practice, however, the choice of the cutoff may be fixed by program objectives and budgetary considerations. In many cases, program managers may wish to target only that segment of the population that is most food insecure. This is likely to be the targeting objective in cases when the program budget is insufficient to address the needs of all who are considered food insecure. Under these circumstances, the best targeting cutoff is one that will deliver exactly the number of participants for which program resources suffice (Habicht, Meyers, and Brownie 1982). In other words, the cutoff would be set at a value corresponding to the percentage of the population that can be served with available program resources.

Selected Method of Quantitative Analysis

After careful consideration, the chosen method for this study is the two-by-two contingency table. For illustrative purposes, the cutoffs for the alternative indicator are set at either the lower 25 percent or the upper 25 percent of the distribution. The candidate indicators are then "screened" and tested statistically for the strength of their association with the benchmark indicator of interest (e.g., household and preschooler food insecurity, or micronutrient insecurity). We underscore that the selected cutoff levels do not represent "the optimal cutoff" for this indicator. Rather, this method exemplifies a practical scenario faced by program staff and, more importantly, represents a level of analysis that is possible for program managers in India and elsewhere in the developing world.

INDICATOR SELECTION CRITERIA

The choice of a targeting indicator should be based not only on its statistical strength of association with a known benchmark of food insecurity, but also on the total costs and benefits associated with collecting and using that indicator. The benefits of using an indicator include (1) correctly excluding from a program the individuals that are truly food *secure*, and thus avoiding the cost of a wasted intervention (leakage), and (2) correctly including food-insecure individuals into a program, and thus reducing the social costs associated with unchecked food insecurity. The social costs of food insecurity include the psychological cost of hunger, decreased physical and cognitive development in children, the value of foregone income as a result of lower

[6] This is optimal in the sense that the maximum of this sum maximizes the measured difference in prevalences (between groups or over time), on average.

productivity and risk-minimization strategies, the costs of additional health care, and a wide range of other economic costs.

Thus, the total benefit derived from effective targeting is a combination of (1) a reduction in the social costs of food insecurity and (2) a reduction of financial costs of providing benefits to those who are not truly food insecure. The latter (termed a reduction in program leakage) amounts to a reduction in the program costs per food-insecure beneficiary. Total benefits, however, should be assessed *net* of those obtained under the default targeting system (i.e., either no targeting or targeting with a benchmark indicator).

Note, however, that by definition, no alternative indicator can out-perform the benchmark measure of food security in terms of identifying the truly food insecure. As a result, relative to the benchmark indicator, targeting with an alternative will always result in some program leakage and some suboptimal reduction in social costs, just by virtue of the fact that it cannot be as accurate as the benchmark indicator.[7]

The issue of less-than-perfect targeting with an alternative indicator is important when we consider the net costs and benefits of using an alternative indicator. Note that the correct criteria for choosing an alternative indicator involves more than the size of the expected social benefits plus program-level savings. Rather, the correct criteria will include the size of the expected benefits *net* of indicator data collection costs. As such, an alternative indicator will only be useful for targeting if it can provide significant data collection savings over the cost of the benchmark. Therefore, an alternative indicator may not be viable if the difference in data collection costs is small. Under these conditions, the savings associated with collecting an alternative indicator may not outweigh the loss in program benefits provided by "perfect" targeting with the benchmark.

Thus, the correct criteria for choosing an alternative indicator involve more than assessing the size of the expected reduction in social costs plus the reduction in program leakage. It must also take into consideration the cost of data collection. For example, assume that "perfect targeting" with a benchmark indicator reduces total costs (program plus social) by $200,000 compared to the case of no targeting. If the cost of collecting the benchmark indicator is $75,000, then the *net* cost reduction from using the benchmark is $125,000. Assume further that targeting with an alternative indicator results in a $150,000 reduction in total costs when

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[7] Note that in a field setting, it is possible for an alternative indicator to be more accurate than a benchmark indicator if it is more objective in its interpretation than the benchmark. Consider, for example, a situation in which individuals are likely to bias their responses to an benchmark query because they perceive that they will receive a benefit if a they give a certain response (e.g., underreporting income). An alternative indicator may be more accurate than a benchmark if respondents are less likely to bias a response to an alternative query (e.g., frequency of meat consumption).

compared to the no-targeting case. In this example, using the alternative indicator is warranted only if the cost of data collection is less than $25,000; otherwise the net reduction in costs would be less than that provided by the benchmark indicator ($125,000).

The decision to use a targeting indicator can be formalized into a cost-benefit problem. Targeting indicators, for example, should be selected such that they maximize the social benefits derived from the program, while minimizing the combined social and program costs (including indicator data collection costs). This is equivalent to choosing the targeting method that maximizes the program cost-benefit ratio, as specified:

$$\max_i \frac{B_i}{C_i}, \quad for\ all\ \frac{B_i}{C_i} > 1, \tag{1}$$

where B_i = social benefit of program targeted on indicator i, and C_i = total (social plus program) cost with intervention targeted on indicator i.

In this formulation, the total benefit of the program that is targeted using indicator i can be defined as the extent to which the social cost of food insecurity is reduced. In theory, this can be calculated as the number of truly food-insecure individuals receiving benefits under the program (true positives or TP) multiplied by the per capita social cost of food insecurity[8]:

$$B_i = sTP_i, \tag{2}$$

where s = per capita social cost of food security problem, and TP_i = number of true positives obtained with indicator i. In practice, however, the social cost of food insecurity is difficult to measure (this issue will be discussed below).

As represented in Equation (3) below, the calculation of total costs includes

program intervention costs:	the cost of providing goods and services to each participant in the intervention multiplied by the total number of participants in the program (including those identified by the targeting indicator who are truly food insecure [true positives] and those identified by the targeting indicator who are not truly food insecure [false positives]);
social costs of remaining	the per capita social cost of the food security

[8] Depending on whether the intervention alleviates all or only a part of the food security problem, the social benefit of an intervention consists of the social cost of the problem in the absence of the intervention multiplied by the fraction which the intervention actually addresses. Equation 2 assumes that the intervention solves the problem completely.

food insecure: problem of concern multiplied by the number of truly food-insecure individuals who are misclassified by the targeting indicator and do not receive benefits under the intervention (false negatives); and

targeting costs: the costs associated with identifying targeting indicators and collecting and analyzing this information from individuals who are candidate participants in the program.

$$C_i = r(TP_i + FP_i) + sFN_i + D_i, \quad \textbf{(3)}$$

where

r = per capita program costs,
FP_i = number of false positives obtained with indicator i,
FN_i = number of false negatives obtained with indicator i, and
D_i = targeting costs using indicator i.

With some types of interventions, there might be additional costs associated with treating false positives. Some health interventions, for example, produce deleterious side effects in individuals that are incorrectly diagnosed. These side effects can represent costs over and above the financial costs of program leakage. For food security programs that are focused on energy supplementation (as opposed to vitamin A megadose supplementation) we believe that it is appropriate to assume that the intervention has no negative side effects and, indeed, will probably generate benefits for the false positive recipients. In such cases, the cost of a false positive is limited to the financial cost of the intervention (program leakage costs) and the social costs of a false positive are equal to zero (see Habicht, Meyers, and Brownie 1982).

As may be apparent, the actual calculation of the social costs of food insecurity and malnutrition can be quite complicated. Leaving aside the question of the physical and psychological costs, it is difficult to measure the economic costs of food insecurity, given the difficulty of quantifying the costs of lost productivity, additional health care costs, and other direct and indirect effects (Strauss and Thomas 1995). Therefore, comparison of targeting indicators on the basis of a complete accounting of costs and benefits may not always be possible.

On the other hand, calculating the program costs involved in delivering a set of goods and services to program beneficiaries is relatively straightforward, as is the determination of targeting costs. Obviously, these costs are likely to vary significantly across contexts. In particular, data collection costs, even for similarly defined indicators, can vary significantly from program to program, depending on the method of data collection utilized and the ability to share costs or

"piggy-back" targeting efforts on to other program functions. In the research setting, for example, data collection costs can be quite high. In most cases, staff for data collection, data entry, and preliminary data analysis are recruited and trained specifically for the research survey, implying high labor and training costs. Equipment such as computers may also have to be specially purchased for the research effort as well. Where population densities are low, or survey locations are spread out across distant locations, the logistics costs of information gathering for research purposes may also be quite large.

In contrast, in an operational context, where well-trained program staff are already in place in the field, the requirements for additional staffing, equipment, logistics, and training costs are likely to be minimal. In the program setting, the cost of information is likely to represent primarily the opportunity cost of the time of existing field staff. This cost itself will vary considerably, not only with the complexity of the data collection task, but according to whether the information is gathered at a central program location or requires visits to individual households. An important concern in any program-based data collection effort is the possible erosion in the quality of the goods and services provided under the program, given excessive data collection and reporting requirements. This fact underscores the need to identify relatively simple indicators for targeting purposes.

The development of any targeting system is likely to entail two potentially separate data collection efforts with significantly different staffing and cost implications. First, in the initial stages of the program operations, some type of qualitative and quantitative fieldwork will be necessary to identify and test candidate indicators. Second, in the course of program operations, the screening of households or individuals for participation in the program according to the selected targeting indicator(s) will represent an ongoing data collection effort that may be quite distinct from the first. To the extent that the assessment of targeting indicators can be linked to baseline data collection activities of a program monitoring and evaluation system, for example, there may be opportunities to significantly contain the information system costs.

This study will focus on methods to be used in the initial evaluation of targeting indicators, rather than operational issues related to ongoing program screening. Because the present research activity is unable to mirror data collection costs incurred in a program setting—particularly ongoing screening costs, this study will carry out various targeting simulations to illustrate the method for determining the worth of an alternative indicator. The simulations will first illustrate the potential reduction in program leakage from improved targeting under a set of fixed assumptions regarding the size of the program and the per capita program costs of an intervention. The simulations will also address the issue of the social cost of food insecurity by defining the range of social costs over which the choice of an alternative indicator may (or may not) be appropriate. In cases where these ranges fall outside the set of realistic estimates of the likely social cost of food insecurity, clear choices among indicators may still be possible.

4. STUDY DESIGN

PROJECT SITE

Four villages were chosen for the study. All four villages were part of ICRISAT's longitudinal Village Level Studies (VLS) conducted between 1975-84 (Old VLS) and 1989-90 (New VLS). These data have been the subject of many studies and are well documented in Walker and Ryan (1990).

Visits to the six villages in March 1992 indicated that a six-village study would be logistically difficult.[9] Instead, a four-village study of Kanzara, Shirapur, Aurepalle, and Dokur was proposed. Kalman and Kinkheda villages were dropped from the sample since agricultural conditions in Maharashtra were found to be more variable between districts rather than within districts. Specifically, rainfall patterns (and hence crop performance) were quite similar in Kanzara and Kinkheda, yet they varied considerably from those found in the dry Sholapur District, where Kalman and Shirapur were located. In the Mahabubnagar villages, the significant variability in cropping patterns and irrigation practices prompted us to retain both villages (Aurepalle and Dokur) in the sample.

The four study villages are located in three districts in two states of India. The villages are described in Chung et al. (1996, Appendix 3). Dokur and Aurepalle are located in Mahabubnagar District in Andhra Pradesh, Shirapur is in Sholapur District, Maharashtra, and Kanzara is in Akola District, Maharashtra (see Figure 2). The village economies are based on rainfed agriculture, but rainfall is low and is particularly erratic in Mahabubnagar and Sholapur Districts (see Table 3). The villages are rural and have agrarian-based economies, but are quite diverse economically and agroclimatically.

Aurepalle, a village that was once the worst-off economically (Walker and Ryan 1990), is situated in an area that is prone to droughts. The soils are poor and most farming is dryland. The increasing value and demand for two rural products, toddy (local liquor) and sheep, has diversified the village economy away from crop production. The effect has been to make many

[9] More specifically, we were constrained by our inability to find investigators that were fluent in Marathi and could carry out the nutrition surveys. Constraining the survey to four villages meant that fewer Marathi speakers were needed. The four-village survey was also more economical.

Figure 2 Map of the study site

Source: Walker and Ryan (1990).

Table 3 Summary statistics for the four study villages

Characteristic	AUREPALLE	DOKUR	SHIRAPUR	KANZARA
Location	Mahabubnagar, Andhra Pradesh	Mahabubnagar, Andhra Pradesh	Sholapur, Maharashtra	Akola, Maharashtra
Distance from Hyderabad	70 kms south	125 kms south	365 kms west	528 kms north-west
Rainfall (general)[a]	Unassured; 630 mm	Unassured; 630 mm	Unassured; 630 mm	Assured; 890 mm
Total rainfall in 1992 (monthly standard deviation)[b]	428 mm (38.72)	578 mm (57.11)	319.4 mm (36.17)	450.6 mm (94.78)
Soils[a]	Red soil Low water retention	Red soil Low water retention	Deep black clay soil; high water retention	Medium deep black clay soil; medium water retention
Major crops[a]	Kharif sorghum, pearl millet, caster, paddy, pigeon pea, groundnut	Kharif sorghum, pearl millet, caster, paddy, pigeon pea, groundnut	Rabi sorghum, pigeon pea and minor pulses	Cotton, sorghum, mung bean, pigeon pea and wheat
Number of households in 1975[a]	476	313	297	169
Number of households in 1989-90[b]	664	464	451	292
Percent laborers[a]	31%	24%	33%	32%
Dominant caste groups[a]	Reddis	Reddis	Marathas Dhangars	Mali Marathas
Percent literate adults[c]	32%	29%	49%	66%
Average per capita landholdings (hectares)[c]	1.46	0.77	1.95	1.94
Mean household energy intake (kcal per adult equiv per day)[c]	2,265	2,298	1,957	2,044
Mean iron intake (mg per adult equiv per day)[c]	9.5	7.8	17.4	17.4
Mean carotene intake (ug per adult equiv. per day)	408	528	1,248	864
Average per capita land cultivated (hectares)[c]	1.18	0.31	1.58	1.90
Mean per capita total expenditure (rs per week)	58	45	67	41
Average price of sorghum (rs per kg) (3 seasons)	3.08	3.20	5.10	2.97
Average price of market rice (rs per kg) (3 seasons)	5.37	5.10	5.84	6.72
Average 1992-93 male daily wage (rs/day)	18	20	25	22
Average 1992-92 female daily wages (rs/day)	10	11	12	14

[a] Walker and Ryan (1990, 4).
[b] Unpublished ICRISAT data.
[c] ICRISAT-IFPRI. 1992-93. Alternative Indicators Study.

of the landless relatively well-off, so well-off that many have begun to acquire land. Farming continues to be a major occupation, however, with the majority of plots still rainfed.

Dokur, like Aurepalle, is situated in Mahabubnagar District, but is significantly different in two respects. First, the land is heavily irrigated, primarily from a large local tank. The effect of irrigation is clear: opportunities for employment are greater in the post-rainy (r2) and summer (r3) seasons. Second, the villagers in Dokur are accustomed to migrating for work during the "slack" seasons. Typically, villagers join "work gangs" to find temporary employment in construction or agriculture. Migration opportunities therefore provide alternative sources of income during the slack season or during difficult years.

Shirapur is situated in an area characterized by frequent droughts and erratic rainfall. The village economy is very much dependent on local crop production. A government Employment Guarantee Scheme (EGS) provides work for villagers, but the demand for labor is inconsistent as well as insufficient to employ all that need work. Shirapur is located relatively close to Sholapur city, but there is no tradition for migration in this village.

Finally, Kanzara is located in a rain-assured area of Akola District, hence dryland farming is less at the mercy of the monsoon. In addition, significant employment is usually available during the post-rainy (r2) and summer (r3) seasons as canal irrigation is available. Kanzara, however, is situated at the end of the canal, so irrigation is not always assured. Neighboring villages, however, have more assured access to canal irrigation, so there is usually a great deal of stability to labor demand. The year in which our study was conducted, however, proved to be a difficult year for this village. Canal water was withheld, so much less land was planted during the rabi season. In addition, untimely rains during the late kharif season ruined the sorghum crop, causing sorghum prices to plummet.

DATA COLLECTION METHODS

Two different styles of data collection were used for this study. The multiple forms of data collection reflected our interest in (1) examining qualitative and quantitative methodologies for identifying and testing alternative indicators and (2) determining whether food security indicators are robust to method of investigation. Insights from this process may suggest that one method is more feasible or desirable under certain conditions.

Quantitative Data Collection Methods: Economic and Nutrition Surveys

Both economic and nutrition data were collected for this study (see Chung et al. [1996, Appendix 4] for details of the survey data collection). Table 4 shows the various modules collected in each of four study villages. Note that several modules offer overlapping

Table 4 Survey information collected during the India study

Number and Names of Modules	Dokur and Kanzara	Aurepalle and Shirapur
Module 1: Household roster		
Module 2: Migration		
Module 3: Education		
Module 4: Occupation		
Module 5: Housing		
Module 6: Land	< < < < < <All households in the sample > > > > > >	
Module 7: Income-generating assets and cropping		
Module 8: Durables		
Module 9: Credit		
Module 10: Expenditures		
Module 11: Dietary recalls	All individuals	All individuals
Module 12: Food frequency	All women, children <6 years	All women, children <6 years
Module 13: Anthropometry	All women, children < 6 years, all males once	All individuals
Module 14: Morbidity	< < < All females > 10 years; all children < 6 years > > >	
Module 15: Breast-feeding	< All mothers of partially or completely breast-fed children >	
Module 16: Reproductive history	< < < < < All females married or engaged > > > > >	
Module 17: Vitamin A food frequency	< < < < All children < 6 years; mother of the child > > >	

information. One objective of the survey is to identify the methods that are most successful in the indicator identification exercise.

The survey modules are designed to keep the form of the alternative indicators as simple as possible. For example, income level was not calculated for each household. Rather, the number of income sources and sources of household income were recorded for each household.

Lastly, we have focused many nutrition and health questions on females and children. The focus on children is not new, but the focus on women who are not mothers is new. This focus reflects a growing recognition that women contribute significantly to household food production and, in many cases, are the sole providers of food. In such cases, it becomes important to understand that women's health status plays an important economic role within the household and may therefore have an impact on food and nutrition security beyond that associated with reproduction.

Qualitative Data Collection Methods

In addition to the survey data, qualitative data were also collected in two villages: specifically, participatory rural appraisal (PRA) modules, season-specific village-level ethnographic reports, and six case studies of selected families. This information is used to (1) develop unique location-specific indicators of food and nutrition insecurity and (2) provide qualitative support for the information produced by the survey.

Participatory Rural Appraisal (PRA). Large surveys are often justly criticized for being inappropriately designed and disrespectful of local knowledge. One way of countering this criticism is to gain more information about the local context and to design surveys that are appropriate to this setting. Another approach is to employ data collection methods that encourage researchers to listen to, and learn from, respondents (Chambers 1991). Specifically, PRA data collection embodies the principles of "optimal ignorance" (not trying to find out more than is needed) and "appropriate imprecision" (not measuring more accurately than is necessary for practical purposes).

The use of PRA techniques offers the possibility of obtaining a holistic picture of individual/family/community food security interactions while reducing the costs of data collection. The application of the approach to nutrition and health is relatively recent (Bentley 1988) and has been mostly limited to project development and evaluation. However, recent research experience focusing on the complementary nature of qualitative and quantitative methods for evaluating health and nutrition status has proved to be quite successful (Paolisso and Regmi 1992).

To explore the use of PRA as a research tool for generating indicators, three different PRA exercises were conducted concurrently with the survey work. The three exercises chosen

for the study were village mapping, food charts, and seasonality charts (see Chung et al. [1996, Appendix 5] for the Guideline to PRA Methods for this study). Village mapping is used to identify households that are at "*very high risk*" and "*no risk*" of food insecurity *as defined by the villagers*. Essentially, the method involves asking a group of villagers to draw a map of their neighborhood. Typically, the map is drawn on the ground using *rangoli* (or colored powder) provided by the investigators. The same group of villagers is then asked to identify households that are "very high risk" of food insecurity *by local standards*. The villagers then provide reasons for why these households were chosen. These "reasons" serve as *emic* or locally-defined indicators of food insecurity.

The identification exercise is conducted separately for men and women in order to measure gender-differentiated perceptions of risk. Figure 3 shows a map drawn in Aurepalle during the last round in 1993. Figure 4 shows an example of a completed map.

The construction of food charts was undertaken at the household level. The key informant in each household is the person in charge of cooking. The informant is asked to list the foods eaten in this season by the household. No attempt is made to standardize the number of foods reported by the informant: the fact that an informant wishes to list two types of sorghum as opposed to one may be a valuable indication of diet diversity or household coping. The investigator then places a small bag with a sample of the food on a sheet in front of them to represent each food. The informant is asked to place ten beans in a column above the food item most consumed, and one bean on top of the food item least consumed. Next, the informant is asked to place a colored bean below each food item to signify the frequency of consumption. Consumption of other foods is rated using 1-10 beans, using the two foods just identified by one bean and ten beans. Figure 5 shows an upper caste woman in Shirapur completing a food chart. The finished food chart is shown in Figure 6.

The third PRA method used is the seasonality chart. This method is conducted with small groups (differentiated by gender and caste) to understand the yearly changes in rainfall, harvests of two main staples, food consumption, male and female labor demand, childhood illness, and women's illness. Separate groups of men and women are asked to "make a picture" of how the above aspects of village life has varied throughout the past 12 months. The group is asked to place 10 beans of one color in a column above the month in which a particular characteristic (e.g., rainfall) is highest. The group is then asked to place one color in a column above the month in which the same characteristic is least evident. The remaining months are rated or ranked using these two endpoints as reference points. The result is a histogram-like picture with anywhere from one bean to ten beans above each month, illustrating the seasonal trends over time. This exercise is then repeated with a group of higher caste to

Figure 3 Village map drawn in Aurepalle, Round 3

Figure 4 Example of a completed village map

Figure 5 Upper caste women in Shirapur, completing a food chart

Figure 6　A completed food chart

capture intra-village heterogeneity in perceptions. Figure 7 shows a group of low-caste men charting availability of work in Aurepalle. The figure shows that the exercise is characterized by lively discussion. Figure 8 shows a close-up of a completed seasonality chart. Note that pictures of local festivals and agricultural events are used to depict the months of the year. Pictorial representations increase participation by illiterate villagers.

Ethnographic Case Studies. In a further attempt to learn how villagers describe the concepts we understand as "hunger" and "food insecurity," an ethnographer was placed in Shirapur and Aurepalle for the duration of each survey round. The ethnographer used in-depth interviews, key informant interviews, focus groups, and participant observation to conduct six household case studies as well as village-level profiles during each round. The case study work was used to develop unique, *emic* indicators of food insecurity (defined by locals or "insiders"). These indicators will be compared with the *etic* indicators produced by the survey (defined by the researchers or "outsiders").

Although the case study method is meant to be fluid and unstructured, general guidelines (Chung et al. 1996, Appendix 6) for the team of ethnographers were developed. The guidelines include the following topics:

1. What are local perceptions of "health" and "food security"? What community, household, and individual resources are required to obtain health and food security? Does this vary by sex and age?
2. Within this community, what are traditional early signs of "food insecurity"? How are "high risk" households or individuals identified by local people?
3. What is a "good quality" diet? In times of plenty or scarcity, how does this diet change and what are the consequences of change?
4. What has been the experience of local people regarding fluctuations in food or nutrition insecurity? What factors are perceived to be responsible for these fluctuations? How do rural households cope with threats to food or nutrition security? What do people do to protect food/nutrition security?
5. What is the decisionmaking process within the household with regard to achieving food/nutrition security or responding to problems in its attainment? Who makes specific decisions, how are resources allocated/reallocated? What is the bargaining power of different family members?

Figure 7 A group of low caste men charting the availability of work in Aurepalle

Figure 8　A completed seasonality chart

Biochemical Analyses

To provide objective "benchmarks" of micronutrient adequacy, serum measurements of vitamin A and iron status were collected for preschoolers and their mothers in two villages. Hemoglobin samples were analyzed using the filter paper technique developed by NIN (NIN Annual Report 1986). Vitamin A samples were analyzed using a variation on the microfluorometric technique reported in Sivakumar (1977).

CHOICE OF HOUSEHOLDS SURVEYED

The size and composition of the sample was selected to (1) maximize the use of the Old VLS time series for future analyses of structural factors affecting current food and nutrition security and (2) maximize intra-village variability.

With regard to the first objective, the three-village Old VLS time series contains a household-level time path of the economic status of 120 households over 10 years. In addition to the Old VLS time series, the Six Village Nutrition Study provides a 15-year-old nutrition baseline for individuals in the 240 Old VLS households. The children in this data set are now adolescents and adults and many have separated into families of their own. Combined with a present-day follow-up of the same households, these data permit a comparison of nutritional status and economic well-being during childhood and adulthood.

To maximize the number of cases on which longitudinal contrasts may be performed, it was necessary to (1) resurvey as many of the OLD VLS families as possible and (2) survey the households of individuals who have separated from the original OLD VLS household ("spin-off families"). An investigation of the spin-off families required an increased survey burden in each of the OLD VLS villages, so the number of villages investigated needed to be reduced.

To maximize intra-village variation, the sample was expanded beyond the Old VLS sample and their spinoffs. Specifically the new VLS households were included and a few "non-VLS" families were added to bring the sample up to 80 households in each village. In total, 320 households were surveyed from the four villages. The total sample represents 17 percent of the total number of household in the four villages.

Unfortunately, the longitudinal analysis, beyond our three-round 1992-93 analysis, proved to be infeasible, given the resources available to the project. The primary difficulty lies in linking individual records across the two data sets. Past documentation is available on the household-level data, but individual-level records are not as clean. Therefore, further cleaning of the Old VLS data set are necessary before the two individual-level data sets can be linked. The data in this study have, however, been collected so as to permit a future analysis of this issue.

TIMING OF SURVEY ROUNDS

The semi-arid climate of the study villages results in seasonal variations in food production, labor demand, and purchasing power (Behrman 1987). As such, we surveyed during three rounds corresponding to the late monsoon (round 1, "late kharif"), post-rainy (round 2, "rabi"), and late summer/early monsoon (round 3, "late summer or early kharif") seasons.

Figure 9 shows the timing of the crop cycles in the four villages. The kharif season varies regionally, but generally runs from June through October in the study villages. The rains may begin as early as June, but they often do not make a significant start until later in the kharif season. The late kharif season tends to be the busiest season in all villages (except Shirapur), since it is the main cropping season. In Shirapur, by contrast, farmers plant at the end of the rainy season, so the post-rainy (r2, rabi) season is the busiest time. The main staple crop harvest usually takes place in late October in Kanzara, November in Aurepalle, December-January in Dokur, and February in Shirapur. In all villages, smaller staple crop harvests occur during other parts of the year. In general, however, the late summer/early kharif time is a period of relative scarcity for all villages, since the smallest staple crop harvest is obtained at this time. Furthermore, in 1993, the monsoon began late and, as a result, little to no agricultural activity occurred in the last round of data collection (late summer-early kharif season).

The longitudinal dimension of data collection is important for areas characterized by heavy seasonality. If only one round of information is collected, the researcher assumes that the relationship between the true food security status and the alternative indicators is stable over time. This may be true for some indicators, but an indicator that identifies *chronically* food-insecure households in one season may not perform during the next season. It is therefore important to follow households over time so that we may identify indicators that (1) identify households that remain consistently food insecure and observe what indicators are independent of changes in season and (2) use alternative indicators to predict households that move in and out of food security, experiencing *acute* periods of food insecurity. Only longitudinal data provide this opportunity.

5. QUALITATIVE RESULTS: INDICATORS OF HOUSEHOLD FOOD INSECURITY

The qualitative methods described above were applied in two villages, Shirapur and Aurepalle. Over the course of approximately one year, researchers used the participatory and case study methods to elicit information on local perceptions regarding food insecurity.

Figure 9 Timing of the three survey rounds in the four study villages

Village	1992 Aug.	Sept.	Oct.	Nov.	Dec.	1993 Jan.	Feb.	Mar.	Apr.	May	June	July
Aurepalle												
Round			1					2			3	
Typical food availability			surplus					medium			low	
Season			kharif					rabi			late-summer/ early kharif	
Dokur												
Round	1					2					3	
Typical food availability	low					surplus					low	
Season	kharif					rabi					late-summer	
Shirapur												
Round			1				2				3	
Typical food availability			low				surplus				low	
Season			kharif				rabi				late-summer/ early kharif	
Kanzara												
Round		1				2					3	
Typical food availability		medium				surplus					medium-low	
Season		kharif				rabi					late-summer/ early kharif	

Triangulation between the various qualitative methods produced the set of indicators shown in Table 5 The evidence for each indicator is discussed below.

PRODUCTIVE ASSETS: LAND

In Shirapur and Aurepalle, villagers commonly identified landholdings as an important determinant of a household's ability to provide food for its members. During the mapping exercise, villagers cited reasons for identifying certain households as "food insecure." In both Aurepalle and Shirapur, villagers indicated that roughly 40 percent of households were food insecure due to landlessness or lack of good quality land. The in-depth case studies supported this finding. Specifically, many case studies showed that landless families are day-by-day uncertain whether they will find work. In Aurepalle, Chinnama's family of seven is landless

Table 5 Household indicators identified by the qualitative analysis

- Poor quality land or landless
- Distress sales of large livestock or small livestock
- Distress sales of other productive assets
- Distress sales of other "valued" assets, e.g., jewelry
- High number of small loans, especially from informal sources (neighbors, relatives, and shopkeepers)
- Choice of drought tolerant crops when more profitable, but risky options exist
- Heavy reliance on wage work
- Women who work for wages who have young children
- Accepting permanent laborer positions
- Few income earners in large family
- Purchase of staple grains on a more-than-once-a-week basis
- Substituting inferior quality staple foods for preferred quality
- Substituting inferior quality vegetables or legumes, or going without
- Substituting gruels for the main staple (to stretch consumption)

and she cannot think of sitting home for a single day. She states, "if I lose wages for one day, then we must struggle for two days to eat." Similarly, in Shirapur, Krushnabai, a landless widow, depends heavily on her partially disabled son's wages to buy groceries..."if and when he gets them." Owning land, she claims, would make it easier for them to obtain loans. In addition, they could at least lease the land out and collect rent. This would take the pressure off days when no wages are earned.

Quality of land appeared to be more important than quantity in determining the food security status of the family. In Shirapur, the Gofne family owned five acres of dry land. Lack of irrigation meant that farm production hinged on receiving abundant and timely rainfall. In Shirapur, roughly three years in five are poor rainfall years, hence the risk of poor crop production is great. This year was not unusual: Pandhari Gofne of Shirapur received only 50 kilograms of sorghum from his land, just enough to feed his extended family for a month.

By contrast, access to irrigation meant that inferior land could be fairly productive. Therefore, households with a modest amount of fertile land or irrigation were often better-off than those with larger plots that were dry and unfertile.

PRODUCTIVE ASSETS: LIVESTOCK

Although lack of land seemed to be the most commonly cited reason for food insecurity, observation and interview revealed that livestock ownership or sale might also be a good indicator. In both villages, the ethnographers observed that poor households rarely owned large livestock. In Shirapur and Aurepalle, large draft animals, specifically bullocks, are necessary to plow the land. Bullocks are so essential that many farmers do not cultivate their land if they do not have access to them or do not have any cash to rent them. The most resource-poor households lack relations with those who own bullocks. A. Sayalu of Aurepalle, for example, owns 2.5 acres of low quality land (*banjar dubba*). Since he does not have access to a bullock, he must either borrow money from the village moneylender (*savakr*) to rent them or let his land sit idle. This year, Sayalu decided to let his brother graze animals on the land rather than farm it. Larger farmers, by contrast, owned a number of large livestock such as cows, bullocks, and buffaloes. These households typically owned irrigated land, which reliably provided crop wastes to feed the animals.

Despite the advantages of owning large livestock, these animals could also become an unnecessary burden to families living on the edge. Usually, if a poor family owned any large animals, it was just one or two. During bad agricultural years (such as the year of our study), fodder and water prices were high and these households could not afford to feed the animals. In Shirapur, for example, the Gofne family was forced to liquidate what seemed to be a profitable asset. Deepak Gofne explained that their bad harvest meant that they must spend exorbitantly to buy fodder for the bullocks.

The experience of the families who owned buffaloes and Jersey cows was similar. Even though Sumit Navendra of Shirapur owned one-and-a-half acres of irrigated land, he could not get enough fodder to feed his three Jersey cows. With the cost of fodder rising, Sumit Navendra sold two of his cows and began to half the amount of fodder fed to his remaining cow. Milk production, he predicted, would fall and it would probably be unprofitable to maintain the last one. Nevertheless, he felt sentimental about this cow and kept it because it was "lucky." Feeding a Jersey cow, he claimed, was like "raising an elephant" (*hattilla poslyagat*).

Because large livestock often generate income, households are reluctant to liquidate them. However, when they do, it is because they have no other choice. Shaik Abdul Ahemad, an attached laborer[10] from Aurepalle, was planning to sell a milking buffalo for Rs 2,000, even though it provided roughly Rs 250 per month. He and his wife had no stocks of rice and had already cut down on purchases of vegetables, oil, and chilies. Debtors were demanding their money and Abdul Ahemad saw no other way but to sell the buffalo. Selling the buffalo would pay half the loan and allow him to buy rice for the family.

OTHER PRODUCTIVE ASSETS

During our ethnographic work, we also observed that ownership of various other productive assets could either contribute to the food security of the household or destabilize it. In general, it depended on whether the asset allowed the household to rise out of debt or whether it created more debt. In Shirapur, for example, a middle-aged widow named Annapurna began a small business making *chuhlas*, or mud stoves. Her business did not require any capital and, before long, she had saved some money to put toward a chile grinding device. The remainder she took as a loan. Before long, Annapurna's chile grinding business was providing regular income. Within no time, she had paid off her old debts and was making regular payments against her loan. Buying the chile grinder, she said, was the best decision she ever made.

Not all investments worked out, however. Krishnayya, a well digger from Aurepalle, used Rs 10,000 in savings to purchase a crane with a partner. The crane could be used to remove mud from hand-dug wells. Although he would earn about Rs 1,200 for each well contract, Krishnayya miscalculated the demand for the crane as well as the costs of paying a team of laborers to work the crane. As a result, his crane sat idle and his other debts, totaling Rs 1,700, were unpaid. He took another loan to buy some dry land, but the poor rains meant no harvest this year. Later in the year, we learned that he was forced to migrate to the city to repay his debts.

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[10] Attached laborers are persons who agree to work full-time for one employer for a specified period of time, usually a year or an agricultural season. The laborer typically receives meals, an in-kind payment of sorghum or rice, and a single lump sum payment. During the 1992-93 agricultural year, the going rate for an attached laborer was 2,000-3,000 rupees per year (roughly US$700-1,000). In Aurepalle, this arrangement is called *jeetam*. In Shirapur, it is called *chakari*.

LIQUIDATABLE ASSETS: SMALL LIVESTOCK, JEWELRY, AND ROOF TILES

Villagers of Aurepalle and Shirapur also invested in items that could be liquidated rapidly and without hassle. The most common asset of this category was small animals, such as goats and sheep. Goats, in particular, did not require special fodder and could survive on "anything green." Acquiring a goat was also not very difficult. Government schemes for those below the poverty line (BPL) were available for buying goats. If one did not qualify for a BPL loan, the local custom of share-rearing allowed a household to acquire an animal by taking care of another household's animal for a period of a year. After the animal has two offspring, the rearer and the owner each take one and the mother is returned to the owner.

Aside from ease of acquisition, villagers reported that goats and sheep were assets that could be sold with relative ease whenever money was needed to repay a debt. In Shirapur, Janabai Mane, an elderly man with three school-aged children, regularly sold sheep whenever he needed cash. Similarly, Krushnabai owned 12 goats and considered them to be her "gold." During times that she urgently needed money, she could sell a goat for Rs 200-600, the equivalent of 20-60 days of wage labor for a woman.

Although small livestock were by far the most common form of liquidatable assets, we observed a few households using other goods as short-term deposits for their wealth. In both villages, we observed that households often liquidate a woman's jewelry when a crisis occurs. For example, Vimal Potdar, a landless woman in Shirapur, had to cope with the costs of a sudden illness. She took a loan using her tin roof as collateral. When she could not repay the loan, she was forced to sell her *mangal sutra*, or marriage necklace, to save the roof. Selling jewelry was also useful to raise cash to make investments, but it often signaled the beginning of more debts. For example, N. Jangayya and his brother both sold their wives jewelry to raise a down payment on a piece of land. They borrowed the rest, roughly Rs 25,000, from a moneylender at a rate of 36 percent interest.

LOANS

Our ethnographers noted that most food-insecure families were preoccupied with obtaining and paying back loans. Both agreed that a good indicator of household food insecurity was the number of small debts owed. Among the food insecure, it was not uncommon to have a variety of debts. In Aurepalle, five out of the seven case study families were heavily in debt. Pedda Balanna said that he had so many loans, he could not remember the number of people he owed. His wife, Mallamma, said that she did not know how to repay these loans. Almost certainly, they will use a system of *adal-badal* (literally "exchange") to repay. By this, Mallamma meant that she will take a loan from one person to pay another and then take a new loan to pay off the second one. The situation of multiple debts was commonplace. Krishnayya Gouda, for example, owed Rs 3,000 to a moneylender, Rs 1,000 to a cousin, Rs 3,000 to his

wife's aunt, Rs 300 to a caste fellow, and a number of small *bakis* (or debts) to clothes merchants and neighbors. The total debt was greater than one year's salary.

In Aurepalle, households held larger sums of debt than in Shirapur. But in both villages, the strategy of juggling small debts from neighbors, shopkeepers, and friends was a remarkably robust finding among the food insecure. Steeped in debt, food-insecure families took small loans (Rs 5 -10) to purchase enough food for one meal. In addition, they borrowed grain, with or without interest, from neighbors, large landowners, and shopkeepers. It was not uncommon for households to have debt at several stores in the village. In Shirapur, for example, Krushnabai explained, "We don't have lumpsum amounts to buy groceries or pay back the credit at once." Instead, she buys on credit from two or three grocers at once, each of whom only allow her a small amount of credit. In this way, Sushilbai juggles her daily food expenses, even though she remains in an endless cycle of debt. Similarly, Sabera holds credit at three different grocery shops. When a shopkeeper refuses to give her credit, she tries to get credit at another until she can pay back the first one.

Poor households also took loans from local moneylenders at high interest rates. Often, the interest amounted to as much as the principle. Pedda Belanna, for example, took a Rs 312 loan four years ago. After four years, the interest and the principle amounted to Rs 650. Villagers also took large loans from banks or cooperatives, but more often avoided these sources, as the paperwork was too troublesome and confusing. In Aurepalle, bank officers were not as strict about collecting on loans and many villagers were lax about repaying. Here, the ethnographer observed that debt was a "web from which it is difficult to extricate oneself." Many of the villagers felt the same way. One attached laborer, from a Harijian case study family, was "drenched" in debt and finally had to migrate from the village, since he had no possible way to repay it all.

CHOICE OF CROPS CULTIVATED

The choice of crops cultivated often signaled the amount of risk a family was willing to accept. The most food-insecure households, whether they held irrigated or nonirrigated land, were more risk adverse and they often chose crops accordingly. For example, among the families that owned dryland, most could not grow a great variety of crops. In addition, most adopted a strategy of growing crops that did not require much water or other inputs. In Aurepalle, caster (a cash crop) and sorghum (a food crop) were common choices among the poorer farmers. Raju Maisayya, a small farmer from Aurepalle, gambled this year on good rain and planted cotton. Rainfall this year was erratic, however, and the cotton did not grow well. His family had urged him to grow either caster or sorghum, since both grow well in dry, low-input conditions. Investing in cotton, his wife said, was "like throwing money on plants" (*chetla pal*). Similarly, in Shirapur, Dyaneshwar Patil adopted the risk minimizing strategy of farming with a partner and

choosing crops that require little water. This year, they are only growing sorghum and Dyaneshwar expects that as much as 50 percent of the crop could fail due to lack of water. Many other dryland farmers in Shirapur followed a similar strategy.

By contrast, among the households who owned land, those who were able to grow risky cash crops were comparatively food secure. Digamber Gharbude, for example, worked as an attached laborer for three to four years and saved enough to dig a well. Ten years ago, they irrigated their land and their income has changed dramatically. They never have to buy grain and they never substitute inferior quality hybrid sorghum for the preferred local varieties. Aside from sorghum, they are able to take on riskier cash crops such as chilies, onions, corn, groundnut, chickpea, red gram, and sugarcane.

The main difference in crop choice between the food secure and food-insecure households seemed to be that the food-secure households could guarantee water for the more profitable crops, such as cotton or chilies. For those that were not food secure, the only strategy was to act risk adverse, that is, to plant a crop that would grow under favorable or harsh conditions. In both villages, the emphasis in choice of crop appeared to be on reducing the likelihood of failure, not on whether it was a cash crop or a food crop. Resource poor farmers often chose cash crops, such as sunflower, castor, or safflower, which did not require good soil, purchased inputs, or abundant irrigation.

WAGE WORKERS

In both villages, wage workers with no other source of income were often food insecure. Women wage laborers of Aurepalle commented that their food security for a particular day depended on whether they got work on that day. Hanumamma, an elderly wage worker who supports her disabled husband, depends almost entirely on wage work, but cannot always get it (see Profile 1). Due to the seasonality of the agricultural cycle, the food security status of agricultural wage workers also followed a seasonal pattern. Most wage workers that were interviewed (irrespective of caste) agreed that the period right after the main harvest was a time of relative food security. During this time work was abundant and they were paid in-kind wages. Conversely, the months preceding the harvest are relatively lean.

For wage working families, the lack of regular work during the lean seasons was often exacerbated by increased morbidity among children. The effect of children's illness on household food security of wage households was clearly stated by the women interviewed: during these periods, women often had to forego wage work in order to look after their sick children.

Profile 1: "I Have Buried Eight Sons"

This case study illustrates how old age and lack of family support make it difficult for elderly households to cope. It also illustrates how a change in the household demographics can make a significant change to the food security of those living on the margin.

When we first interviewed Kavali Mogulanna and his wife, Hanumamma, they were living alone. Mogulanna was 78 years old and his wife was 65. He stopped working last year but Hanumamma continued to go for wage work when she could get it. Mogulanna has become so old that he can't even bathe himself anymore. Nevertheless he reported, "my only problem is age, otherwise I am healthy."

Throughout his life, he worked on and off as an attached laborer. Together he and Hanumamma had nine children. "I buried eight sons," she said, and then described how each of seven children died before the age of five. Two lived past their childhood years. Their one remaining child, a daughter, lives in the same village and is also poor. Hanumamma explained that her daughter sometimes sends them food. She elaborated by saying that they had received one-quarter kilo of red gram *dhal* six months ago.

A long time ago, Mogulanna inherited 3.7 acres of land from his father, but they were forced to sell it to pay debts from the marriage of their one son who survived childhood. Their single asset was a baby buffalo, given to them by her brother. Hanumamma explained why she wanted to sell it. "I am finding it difficult to take care of this animal. It needs a lot of food and water, which I can't provide...I have become very old and don't have the energy to look after it."

In her old age, Hanumamma still goes for paddy harvesting so that she will earn in-kind wages. She was unhappy to admit that many people do not want to hire her anymore because she is not quick and efficient; in addition, her vision is bad. After returning from the fields one day, Hanumamma said that she was so tired that she couldn't pound the paddy she earned for dinner. There was no cooked food in the house, so the two went to sleep without eating. "I will tie my stomach with a cloth and go to sleep (*Kadupu biggera katkoni pandkunta*)," she explained. She had done this many times so that she wouldn't feel hungry.

Aside from occasional harvesting jobs, Hanumamma sometimes works as a sweeper in a wealthy landlord's house. They also receive Rs 90 every three months as an old-age pension from the government. But this is hardly enough to survive; most of it goes right away to pay small debts from shopkeepers and neighbors.

"PERMANENT" OR "ATTACHED" LABORERS

Villagers of Aurepalle and Shirapur agreed that families with an attached laborer (*jeetam*) were usually food insecure. In Shirapur, villagers reasoned that "no one became a permanent servant unless they were desperate" (*nad aslekich Chakari dharato*). At times of crisis, families became attached laborers to obtain lump-sum amounts to pay off loans, while still ensuring a minimum supply of food. Shaik Abdul Ahemad, for example, needed a large sum of money when his wife became ill. He borrowed it from a large landowner and began working as a permanent servant. Balrappa, of the Gofne family of Shirapur, also worked as a permanent servant to pay off the wedding expenses of his younger brother, Deepak. Neither Balrappa nor Shaik Abdul Ahemad were happy with the terms, but agreed that it was the only way to get a large sum of money advanced when they needed it. While Balrappa was able to extract himself at the end of his contract, Shaik Abdul Ahemad appeared to be in a never ending cycle of debt. As such throughout his life, he frequently rendered his services as an attached laborer.

Most permanent servants affirmed that the salary they received was not enough to support an entire family for a year. In such cases, the rest of the family, particularly the women, were under considerable stress to make up the shortfall. Case studies indicated that the relationship between the laborer and the landlord was fairly exploitative. For example, Yadayya of Aurepalle took a Rs 5,000 loan to pay for his daughter's marriage. To repay this loan, Yadayya had to work for his landlord for two years. With the death of his father, however, and the associated costs of a funeral, Yadayya estimated that he would be forced to work another year on an attached contract. Other than the lump sum advance, he received no wages and his wife was completely responsible for supporting their family of five. His wife, Satamma, earned six to seven rupees a day (roughly 18 to 24 cents per day) and saw no end to their problems. "It's better to die rather than live this life," she told an investigator ("*Sacci poinde neyamu e batku kanna*").

We conducted interviews in six households with members that worked as attached laborers. Only one family stated that they thought that permanent labor (*jeetam*) was a good option. Raju Maisayya of Aurepalle, for example, has worked as a permanent servant since childhood for a village "rich man" (*dora*). Maisayya and his wife claim that *jeetam* is good because there is assurance of a lump-sum salary and they do not have to search for work daily. In addition, their landlord is a good man; he provides money, fodder, and grain whenever they need it and pays medical bills. They agreed, however, that the work is hard and that their wages are lower than those of a daily agricultural worker. Nevertheless, his landlord has provided him with loans to buy land and he can farm a small plot. In addition, with his wife's wages, they are able to send their only child to school. Maisayya's experience with *jeetam*, however, appears to be exceptional.

WOMEN WITH YOUNG CHILDREN WHO WORK FOR WAGES

Interviews with our case study families, key informants, and observation in the village indicated that women with small infants who still went for wage work often came from food-insecure households. When asked, villagers agreed with this assertion; local customs dictate that a mother should stay with their children, particularly if they are breast-fed. On the whole, women from food secure, particularly, upper caste families, did not work outside their home or their own farms. Conversely, mothers in food-insecure families had no choice but to go for wage work. In Aurepalle, for example, Balamma took her four-month-old daughter, Manjula, to the field when she works. Her family cannot manage alone on her husband's earnings; he says, "*kashtam chesi batkutunnaru*"—"we are surviving only by working hard." In Shirapur, Manisha also took her infant when she went for sorghum harvesting. During the harvest period, she was employed less than one month, but earned 50 kilograms of sorghum, enough to feed her family for two months.

Many women lamented over having to leave their children unattended while they sought wage work. Jaya Sujatha, for example, passed tenth grade and has a good job in a spinning factory. However, her husband does not contribute regularly to the family income. To feed her family, she will take any job, even agricultural work. Her children "wander the village in (her) absence." "They are too young to take care of themselves," she said, "but what to do?"

MIGRATION IN SEARCH OF WORK

In Aurepalle, migration appeared to be a strong indicator of food insecurity. Wage work within the village was often not available during the lean seasons. Families with no productive activities within the villages sent migrants to cities or to labor-deficit agricultural areas. In Aurepalle, Sayalu migrates in a circular fashion to Hyderabad, 70 kilometers from Aurepalle. There he works as a rickshaw puller for 15 days a month; the remaining 15 days he returns to Aurepalle to be with his family. "I don't have to struggle for jobs. I run a rickshaw in the city and save money for my family," he says. Each month he sends about Rs 250-300 (about US$8-10) to his wife and then seeks work during the 15 days that he is home in the village. If he gets work, then he might earn Rs 100 rupees (US$3) in 15 days. Women also migrated temporarily during the lean season. During the summer (r3) season, four women from the Aurepalle case studies migrated to labor-deficit areas for rice planting or harvesting. All were from food-insecure families that had no other means of making money for food.

Migration, however, appears to be a very village-specific response. In Shirapur, fewer people migrated to the city, even though it was much closer to Sholapur than Aurepalle was to Hyderabad. Investigators claim that Shirapur villagers are not "accustomed" to migrating. In addition, there were several Employment Guarantee Schemes nearby, although none provided regular work and did not employ all that wanted work. Finally, contractors do not come to

Shirapur seeking workers and no groups have formed on their own to migrate as they do in other villages.

HIGH HOUSEHOLD DEPENDENCY RATIOS

Throughout the qualitative work, villagers identified various demographic variables as strong determinants of household food security. More so than the absolute size of the household, the villagers listed characteristics that were related to the number of persons capable of earning money or the number that must be supported by those who work. Many of these variables (e.g., "one person earning," "disabled head of household," "many small children") are related to the *etic* concept of the dependency ratio. For example, the villagers thought that households that were dependent on a single wage earner were at high risk of food insecurity. During the mapping exercises in which they identified the most food-insecure families in their neighborhoods, villagers cited "only one earner" as a common reason for which these households struggled. In Shirapur, for example, 37 percent of the total households identified had only one earner; in Aurepalle, 36 percent of the households identified had one earner.

The villagers also identified households comprised of many elderly or solely elderly members as food insecure. In Aurepalle, 40 percent of households identified during the mapping exercise had an elderly member who could not work for money or could only do light housework. The situation was similar in Shirapur, where 43 percent of the identified households were identified because they had old members. Villagers also noted that many of these elderly households did not have any social support; either their sons did not support them or they did not have any sons. Consequently, they struggled. In Shirapur, one elderly woman, Malanbai, was identified by all mapping groups as being food insecure. Malanbai described herself as so poor that nobody would invite her to a wedding (see Profile 2). She reasoned that it would be odd to have "a rough woollen piece patching up a fancy sari" ("*shalila ghongadiche thigal kashala*"). In her old age, Malanbai had no children who would care for her and she depended completely on daily wage work to support herself. On days that she had no work and no stored food, she says that she "drinks lots of water and sleeps 'hungry'."

During the mapping exercise, villagers also identified households with several small children as food insecure. This indicator was not as strongly associated with food insecurity as the presence of the elderly. Our case study families provide several reasons for which these household were vulnerable. First, child-bearing and caring responsibilities often kept women

Profile 2: "My body has the habit of work, so it is still working."

This story illustrates that sometimes the only resource an elderly widow has is her two hands.

Malanbai, an old widow, attributed her "downfall" to old age, joblessness, loss of a working son and the lack of social support. She was married to an "attached laborer" before she reached menarche. She never saw her husband in the daylight until her first daughter was born.

During the big drought of 1972, her family ate wild weeds to cope. Nevertheless, she lost her husband and four children. Only one son remained. Soon after their deaths, her brother-in-law drove her family out of their house. Malanbai lived with her son and worked to survive; she earned 75 paisa a day (roughly 2 cents). Her son was good to her, but he died young after he stepped on a nail and contracted tetanus. Her daughter-in-law left with her grandchild, who died soon after. Shortly after, her brother-in-law insisted that she repay 1,500 rupees, which he said her husband had borrowed from him. The village *panchayat*, whom she likened to "God," supported this demand.

It took her four years to pay off the loan, but today she is still extremely poor. She never borrows money and does not run credit at any shops. When she doesn't have money, she eats roti with chile or "*kanya*" without sugar or salt. When she has money, she buys a small quantity of cheap vegetables (like eggplant) or low quality dhal. "I don't even look at potatoes and tomatoes," she commented. Her method of coping with poverty was matter-of-fact. "I don't dare ask anybody for money. If I cannot get anything to eat, I drink lots of water and go to bed hungry."

In her elderly state, Malanbai is still considered one of the best wage workers in the village. She works hard and is honest. Employers often seek her when they need workers. "It makes me happy that they remember me for work," she says. Nevertheless, Malanbai is ostracized by her family and relatives; when she enters their house, they cover their cooked food. They do not invite her to weddings or festivals. "I have cleaned everyone's dirt for so long that now they think that I too am dirty," she said. She stopped visiting her daughter because her son-in-law was suspicious that his wife was feeding her mother.

Malanbai knows that her ability to work is her only asset in life. Fearing that she would be helpless if she became sick, she considered selling the half acre of dryland that she still owned. As soon as her son-in-law and brother-in-law heard, they wanted their share. For the time being, Malanbai had given up the idea of selling her land.

away from wage work. Chinnama, a 24-year-old mother of five, reported that she lost seven days of wages when her daughter was ill. To tide the family over, she borrowed Rs 20 (equivalent to US$.60—two days wages) from her neighbor to buy food. In Shirapur, a 26-year-old mother named Malabai worked until the eighth month of her first pregnancy. She stayed home for three months after her delivery, but then resumed wage work, since her wages were essential for the family.

Aside from the cost of lost wages, children's sicknesses require money for doctor's visits, transport, and medicines, as well as lost wages for the caretaker. Yelliah Gouda, a toddy tapper, complained about spending roughly 100 rupees per month for his children's medicines (equivalent to roughly 10 of his wife's wage days). Similarly Chinnama claimed that in addition to losing her 7 days of wages she had to pay transport costs and doctor's fees when she took her daughter to see a physician in Amangal. Chinnama explained that if she or her husband become ill they can sleep off the fever. However, if the children become ill she must take them to the doctor despite the cost.

BUYING STAPLES ON A DAILY BASIS

Direct observation and interviews indicated that purchasing staples on a daily basis was a strong indicator of food insecurity. Poor people could not afford to buy enough for long periods of time. They bought cereals at least twice a week, usually after the "wage day." Researchers recorded a number of instances in our case-study families where mothers purchased only enough food for a few meals at a time. In Aurepalle, Chinnama and Balamma regularly bought only what they needed as they were dependent on daily wages. Sometimes purchasing grains on a daily basis was part of an intricate food security strategy. In Shirapur, Savita was the second wife of a farmer with some irrigated land. Her husband did not support her. To cope, she said that she would buy sorghum on a daily basis whenever she would get wage work. She would save her bag of storable local sorghum for the leanest season. When questioned, villagers agreed that buying staples on a daily basis was an indicator of food insecurity. The Gofne family commented, "One who can't earn enough to store at least for two or three days will buy every day. They are surely food insecure."

ILLNESS

Households in which working age adults had physical disabilities or chronic illnesses were also identified as being food insecure during the mapping exercises. We also found examples in our case-study families. Laxman Gore of Shirapur became ill at the age of two. As a result of this sickness, his upper right arm became wasted and now he has a problem getting wage work. Similarly, Yelliah Gouda fell from a toddy tree almost 20 years ago. He can still climb toddy trees, but is unable to do heavy work such as well-digging, road making, plowing, or

harrowing. Aside from long-term disabilities, accidents with temporary consequences can bring on large medical expenses, which begin a downward spiral (see Profile 3).

Vinod Manohar of Shirapur used to work on a sand carting truck. However, recently, a motorcycle hit him while he was on his bicycle. One month after the accident, Vinod Manohar was still unable to work and was forced to borrow Rs 2,500 to pay medical expenses. His wife, Archana, said, "Now we have to borrow money for the first time in our life. We are finished."

STAPLE SUBSTITUTIONS

In Shirapur, the normal meal included sorghum *roti* (unleavened bread) with a liquid legume preparation (*dhal*) or a cooked vegetable curry dish. In Aurepalle, the typical meal was the same except rice was substituted for *roti*. In Aurepalle, families substituted broken rice (available for Rs 3 per kilogram instead of Rs 5.25) or ration rice for their preferred rice. One elderly woman was seen collecting rice that was spilled in the field after the paddy harvest. She also collected a black colored rice (*taal buva*), which had been discarded with the chaff while winnowing. Her employer, a large landowner, let her take it when she sifted and pounded the paddy. In Shirapur, poorer families substituted subsidized sorghum available at the ration shop.

When households do not have enough of even an inferior grain (broken rice or ration rice in Aurepalle or ration sorghum in Shirapur), they often resort to making a solid gruel out of sorghum or millet. In Aurepalle, villagers often make *sanketti*, a solid gruel made from boiled millet or sorghum. Traditionally, this is eaten after the October grain harvest (when people are paid in-kind), but during other times of the year, consumption of *sanketti* is considered to be a sign of stress. When asked, the villagers agreed that this pattern of consumption was consistent with food insecurity. In Aurepalle, a group of women from the *madigas* caste reasoned that *sanketti* did not require any accompaniment of expensive vegetables. Furthermore, only a small quantity of grain could be stretched into a full meal by cooking *sanketti*.

Similarly, in Shirapur, families that did not have enough sorghum to make *rotis* ground the available sorghum, boiled it, and made a thick gruel called *kanya*. All case families interviewed in Shirapur explained that they thought this was a certain indicator of food insecurity. *Kanya*, they said, was an "emergency" food, and was usually eaten for a day or two until the family gathered enough resources to buy enough grain to make *rotis*.

In Aurepalle, villagers spoke of another staple substitute, a thin gruel called *ambali*, which is made of pounded rice. Traditionally, *ambali* is drunk during the summer to quench

Profile 3:
"We Have to Borrow Money for the First Time in Our Lives. We Are Finished."

This family's story illustrates how unexpected accidents can set a relatively food-secure family into debt and food insecurity.

Archana and Vinod Manohar live in an abandoned, dilapidated house. Vinod Manohar typically works on a sand carting truck and farms some of his own land. Two weeks ago, Vinod Manohar met with an accident when he was riding his bicycle and hurt his hand and head. He was treated for superficial cuts. Later, he returned to the doctor because his teeth were loose and he felt lots of pain in his jaw. He felt a constant vibration in his head (*dokyala thartharte*). The doctor wired his teeth and jaw and told him to only have milk and an occasional biscuit. He stopped working and his wife began to go for weeding work.

Until this time, the family was doing quite well. Vinod Manohar was an only son and had inherited two acres of dryland. He was a careful farmer and improved the land by manuring. They got good yields and were able to save their money, since they had no children for six to seven years. They bought a cow and fed it well; it was giving two liters of milk a day. Both he and Archana worked and earned about Rs 390 per week (approximately US$13). "We were earning well and our expenses were minimal," he said.

During this time, Vinod Manohar and Archana had no debts. They were doing so well they could afford to spend nearly Rs 10,000 on pilgrimages and rituals so that they could have a child. When Archana became pregnant, they sold the animals so that she could rest. Archana was able to stay home with her son and Vinod Manohar was planning to buy some livestock for her to tend to while at home.

Their plans were dashed with this accident. For the initial check-up, they borrowed RS 500 and the doctor estimates they will need Rs 2,000 more. They had no savings; recently they had spent Rs 4,000 on two acres of land. "Now we have to borrow the money for first time in our life. We are finished" ("*aamachi pachava dharan basali*").

Archana said that they still have one bag of sorghum. They ate one bag of hybrid jowar because it was cheap and was prone to pest infestation (*kid lawkar lagate*). Their bag of local jowar could be stored for two years and would be useful during the rainy season. They were also planning to buy wheat and rice so that the remaining stock of jowar will last them until next harvest.

thirst. One group of upper caste women said that if *ambali* is eaten in the off-season, it is usually a sign that the household is struggling for food. A group of *madiga* caste (scheduled caste) members said that mostly the poor *harjian* households eat *ambali*. "*Ambali* quenches their thirst and kills their hunger" ("*doopa arthadi, aakali chasthadi*"). An old man from the group explained that if they drank *ambali* during the day, they will not feel like eating until the evening. Another concluded, "a woman who has suffered and who is hungry will be able to describe these foods. A woman with a full stomach won't be able to say anything" ("*debballu thinna amma, aakali konna amma chopthadi, kadpu nindina amma aemi chopthadi*").

VEGETABLE AND LEGUME SUBSTITUTIONS

In addition to substitutions for staple foods, observation and interview revealed that food-insecure families often substituted cheaper, more accessible, foods for the traditional *dhal* or curry preparations. Families in Shirapur bought broken legumes, such as broken *toor dhal* (*dalga*) or *matki* (33 percent), since it was half the price of proper split *dhal*. In addition to stretching their legume preparations, they often made a, thin, watery *dhal* dish. Sometimes, they substituted eggplant (a relatively cheap vegetable) or spinach for the more expensive *dhal* (35 percent).

During the summer (r3) lean season, some families were not able to purchase *dhal* or vegetables due to lack of wages. Ethnographers in both villages reported that many families collected wild green vegetables as a substitute. The wild vegetables were abundantly available during this season and, when cooked, did not require spices or oil. In Shirapur, investigators found that food-secure families ate certain wild vegetables just to add variety in the diet. However, for many households, consumption of wild vegetables was part of an important strategy to stretch their food budgets during the lean season. Malanbai, the elderly widow from Shirapur, said that she cooked these wild greens so that she could save money for when her monthly allocation from the ration shop became available. If she did not have enough money on the day the food came, she would have to forego her allocation. In the *harijian busti* (neighborhood), one woman showed the investigator a large pot of boiled wild greens that was seasoned only with salt. She said that this was all her family would have for lunch. One man sitting nearby commented, "What else can we do? We can't even buy oil, salt, or chile powder. (Otherwise) we would just sit (here) and not eat (*tarmadya det basayache*)."

In Aurepalle, observation and interview with case study families also indicated that wild vegetables were an important food resource during the rainy season. Chinnama of Aurepalle collects these vegetables two to three times a week, since she does not need to spend money on them. Eating too much, though, causes vomiting, headaches, and dizziness, commented Balaiah, a *harijian* woman from Aurepalle. She figures that people in the *harijian busti* eat these wild

greens at least three times a week. "We can't help it," she continued, "just like goats eat grass, we eat this like grass."

When families were destitute, they ate no *dhal* or curry. In Aurepalle, our ethnographer noted several times that her case study families ate rice with red chilies (*miraga thoku*) when no vegetables or legumes were available. In Shirapur, the traditional way of eating *roti* included a traditional blend of many spices (called black *masala*). Consumption of *roti* with plain red chili was therefore an indication of food insecurity, since black *masala* contained many ingredients such as garlic and expensive oil. During the food chart exercise, the households that reported that they do not run short of food also said that they liberally used good quality spices. By contrast, the poor used small quantities of fewer spices, just enough to flavor the black *masala*.

One case study family said that only the poor eat *roti* with only crushed chilies. Similarly, Laxmamma, a *harijian* woman from Aurepalle, commented that the landlords "never eat chile powder with ration rice. Why would they? They have enough for generations to eat together."

DOWRIES

Throughout India, the tradition of providing dowries for daughters is a huge burden for poor families. Our study villages were no exception. In Shirapur, Pushpa Prakhesh and her daughter-in-laws were so well-off that they never had to go out for wage work. Nevertheless, she states that they had to sell a lot of land and animals to marry off their three daughters. When asked about her household expenses, she implied that daily expenses were not a problem. However, she remarked, "the major expense is sitting next to you," referring to her fourth daughter.

Many families did not have any resources to sell to raise the dowry money. Instead, they took loans. Janabai Mane of Shirapur had four daughters and one son. For his first daughter's marriage, he borrowed Rs 7,000; for his second, Rs 10,000. Dowries were often multiples of what a family could earn in a single year, hence some people became attached laborers to raise the necessary sum. Many times, dowry money "recycled" itself through some families. The money received from a new daughter-in-law might be used to marry off one of the groom's sisters. It was therefore up to luck whether a family had more girls than boys. Sushelabai had five sons and claimed that it was a "must" to accept the money, even though all the daughter-in-laws had been her husband's nieces. Radhabai of Shirapur has three grand daughters and was clearly on the losing side of the dowry lottery. Realizing this, she lamented "*lokachya tondache zadane potare*,"[11] meaning that dowry not only feeds other people, but also provides for all their future needs.

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[11] Literally meaning, "dowry is like sweeping and cleaning someone else's mouth."

GIFTS AND OBLIGATIONS TO RELATIVES

The ethnographers noted that many of the food-insecure households had taken large loans to fulfill traditional obligations to family. Many respondents claimed that they had no choice and that it was their duty. The Gofne family, for example, frequently did not have enough food to eat. Nevertheless, they felt obliged to have a large celebration for their daughter-in-law's parents when she matured. Deepak Gofne estimated that out of 100 paise (percent), he had saved only 25 paise for the celebration and would borrow the other 75.[12]

In Aurepalle, families that were food insecure also expressed a need to fulfill social obligations. Sabera Abdul Ahemad's family, which has no rice stocks in the house, is contemplating selling their only buffalo to meet debts and buy rice. Her husband worked as an attached laborer to pay off the debt. Nevertheless, they are planning to butcher one of their four chickens when their relatives visit. "We have to provide a nice meal for guests. . . .it is our custom," she said.

Some families got themselves into a cycle of irretrievable debt by fulfilling these obligations (see Profile 4). Nandishilor of Shirapur spent lavishly when his wife's relatives came to visit, buying sweets and clothes for them on credit. To get himself out of debt, he became an attached laborer. His children are losing weight and he admits that it might have been foolish. "The guests might have forgotten the gifts (*aher*) that were given them, but we are still suffering in living hell (*narakwas bhogato*)." For the rich, this was not a problem, but to families living on the margin, it often provoked a cycle of debt from which they could never escape.

RELIGIOUS OBLIGATIONS AND HOLIDAYS

Even the poorest case study households expressed a need to celebrate holidays with new purchases and to fulfill religious holidays. In Aurepalle, Chinnama's family often borrows food or grain from neighbors or shopkeepers. Yet last year, her husband, Sayalu, took a loan from the cooperative bank that was supposed to be used to fund income-generating activities.

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[12] While recounting this story, the investigator commented that the definition of the *marathi* word for gift, *aher*, differs from the Western definition. In English, "gift" implies that something is given willfully; by contrast, in *marathi* "*aher*" is used for gifts that are compulsory and that give social respect to the givers and receivers.

Profile 4:
"Even a Sinking Person Would Try to Hang on to a Small Stick"

This story illustrates how landlessness, debt, unexpected sickness, and social obligations work together to create a situation of food insecurity.

Nandishilor's family has always been poor, so poor that when it became time for him to seek a bride, no one was willing to "make an alliance" with him. Once, while in Pune, he met Vimal and her brother. They also were very poor. Because they were both poor and unmarriageable, they decided to marry each other. Now they live in Shirapur in a two-room house obtained from the Indira Gandhi Yojna. Nandishilor worked on a sand carting truck and Vimal did not work. Some time ago, Nandishilor became sick and needed an intravenous drip. They owned no land, so Vimal borrowed Rs 500 by offering the tin sheets from her roof as collateral. The moneylender demanded that she give him the sheets; rather than live without a roof, she sold her *mangal sutra* (marriage necklace).

The debt situation worsened, however. Some time ago, some distant relatives came to visit and Nandishilor felt obliged to offer them gifts and good foods. The sweets and clothes were purchased on credit and, four years later, the debt has not been repaid.

With interest, the debt became bigger and bigger and lenders started troubling them. Nandishilor was finally forced to accept work as an attached laborer to pay his debts. He received a lump sum of Rs 500 and was given 28 kilos of sorghum per month. The large debt was paid off. But Nandishilor and Vimal were forced to take small loans, since their in-kind earnings were not enough to make ends meet. To supplement their income, Vimal raised a couple hens to buy *mith-mirchi* (daily groceries). The children demand food that they were once accustomed to eating, but Vimal cannot provide it now. They both see that their children have lost weight.

Vimal said they have passed many nights when they both have cried together. Nandishilor feels guilty because he cannot feed his family enough and his wife has to start working. Their children look after themselves and stay outside the house the entire day. "What to do?," she remarked; her wages are their sustenance. Vimal lamented to our investigator that she had no choice but to work. "*Budtyala tinkyacha aadhar*" she said..."even a sinking person would try to hang on to a small stick."

Instead, Sayalu used the money to buy his family new clothes and to celebrate the *dussehra* festival. In Shirapur, Krushnabai, the woman whose postpartum daughter-in-law felt that she could not demand food since she was not working, explained that she had recently bought an "urban looking" outfit for her infant granddaughter. It was her first *marathi* new year and she wanted it celebrated properly.

Aside from holidays, some of our poor case study households undertook unusual lengths to fulfill religious obligations. In Aurepalle, Pedda Balanna (the man who was so steeped in debt that he could not remember how many people he owed) was planning to give up his house and, with his relatives, build a temple on the same site. To buy a new plot and construction materials, he planned to take another loan and sell 20 goats. His wife seemed very proud of their actions and said that during the celebrations at the new temple, her husband will "get god inside of his body."

6. QUANTITATIVE RESULTS

During the course of this study, we considered several different methods to quantitatively evaluate each indicator. The first section of this chapter outlines the choice of method for indicator evaluation. The second section presents the results of a quantitative assessment of indicator performance. The third section uses a simulation to illustrate the potential savings associated with a targeted food distribution program.

ISSUES CONCERNING CHOICE OF METHOD TO DETERMINE STATISTICAL ASSOCIATION BETWEEN THE BENCHMARK AND THE ALTERNATIVE INDICATOR

At the beginning of the project, we identified a method to evaluate the performance of each indicator. This method, known as the overlap procedure, is described in Haddad, Sullivan, and Kennedy (1992). The overlap method basically asks what proportion of households (or individuals) with a certain indicator characteristic is also food insecure? A strong indicator shows a high (and significant) proportion of observations that are in both the food insecure and target groups. The statistical significance of this "overlap" is determined with a simple t-statistic to determine a significant difference between two proportions. Indicators that are identified as "successful" are submitted to a targeting simulation for a final testing of its ability to distribute food aid to the food insecure.

A preliminary analysis of these data used the overlap method to evaluate indicator performance (Chung, Haddad, and Ramakrishna 1994). An evaluation of these results, however, indicated that the overlap method was flawed for evaluating the performance of the alternative indicators (Cogill 1994, personal communication; Khan and Riely 1995). More specifically, the overlap method rewarded indicators that identified a high proportion of food insecure among the

target group, but did not take into account the number of observations misclassified by the indicator. An indicator could therefore appear highly successful with the overlap method, but still be a poor performer due to a high number of false positives and false negatives. Relying solely on this criteria, the analysis led to the misidentification of some indicators as "successful" when, in fact, they had relatively low sensitivity and specificity. In addition, other indicators that the overlap method identified as poor performers were actually no worse in terms of sensitivity and specificity than some of the "successful" ones.

In terms of different statistical methods of association, the biostatistics literature suggested the use of a chi-square statistic to test for a statistical association between the benchmark and the candidate indicator (Rossner 1995; Snedecor and Cochran 1989). Beyond the general choice of a chi-square statistic, we explored options for setting the critical value for determining statistical significance. Parallel examples from the literature were nonexistent since (to our knowledge) no study of indicators has attempted an analysis with more than a handful of indicators. Rather, most quantitative analyses have limited the set of candidate indicators to a small number (usually less than 10) taken from a single discipline (Ruel, Rivera, and Habicht 1995; Ross et al.1995; Glewwe and van der Gaag 1990).

For this study, however, we found it difficult to restrict the number of candidate indicators to only a handful. The reasons are threefold. First, we wanted the set of candidate indicators to reflect a multidisciplinary understanding of food security determinants. The food security literature, however, is extremely broad, since it includes all factors that affect food availability, food access, and food utilization. Our preference, therefore, was to find a single method that could test many indicators simultaneously. This would allow for a direct comparison of performance among indicators that cross disciplinary boundaries (and are thus rarely compared).

Second, for practical purposes, different forms of the same indicators are tested. The reasoning behind this seemingly redundant search is simple: food program practitioners are not always in a position to collect the exact data they require. As a result, they must often use existing secondary data sources. To reflect these constraints in data availability, we tested multiple formulations of some indicators to determine if the formulation affected its performance. As a specific example, we tested several formulations of the dependency ratio to

determine how sensitive an indicator's performance may be to its formulation.[13] We also dichotomized various continuous variables and tested both the dichotomized variable and the continuous variable itself. For example, we constructed a dichotomous variable "at least one preschooler sick with diarrhea. . ." from a variable that gave the number of preschoolers in the household that had diarrhea. Both variables were tested to determine if there was anything to be gained from collecting a continuous variable over a simple dichotomous one.

The typical limitations on data availability also suggests that we should be concerned whether an indicator performs equally well at all times of the year. Does it matter, for example, when we collect data to target the chronically food insecure? Are data from one season just as effective as data collected in another? For this reason, we collected indicators in three seasons and tested each for its association with chronic food insecurity. If an indicator performs equally well across the seasons, then it implies that the timing of indicator collection is not important. This information would be especially useful to organizations with limited data collection budgets.

The three factors described above encouraged us to test the performance of a large number of alternative indicators. All in all, we found over 450 variations of food security indicators suggested by the literature that could be tested with our data. This set of indicators is listed in Chung et al. (1996, Appendix 7) and became our "core set" of alternative indicators. The set was large, however, and this presented a number of methodological problems. First, the test for significant association between the benchmark and the more than 450 core indicators presented a situation of multiple statistical comparisons. Repeating the same "experiment" several times leads to the possibility of obtaining a high number of significant associations purely due to chance. The chance of making such an error can be reduced, using procedures such as the Bonferroni adjustment (Rossner 1995). The Bonferroni procedure adjusts the critical value of the test statistic to ensure that the overall probability of declaring significant differences between indicators and the alternatives is maintained at some fixed level of significance (say α=.05).

The Bonferroni adjustment is a conservative adjustment and it raises the critical value of the chi-square statistic: the more experiments conducted, the higher the value of the critical chi-

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[13] Several version of the dependency ratio were tested:

dependency ratio1 = (# children + # preschoolers)/household size;
dependency ratio2 = # preschoolers/household size;
dependency ratio3 = # cannot work/household size;
dependency ratio4 = (# children + # preschoolers)/(household size - # preschoolers);
dependency ratio5 = # preschoolers/(household sizeR - # preschoolers);
dependency ratio6 = # cannot work/(household size - # preschoolers);
dependency ratio7 = (# children + # preschoolers)/(household size - # cannot work);
dependency ratio8 = # preschoolers/(household size - # cannot work);
dependency ratio9 = # cannot work/(household size - # cannot work);
dependency ratio10 = household size/(household size - # cannot work).

square statistic. For example, the critical value for a single test of association between a benchmark and an alternative indicator is 3.84; for two indicators, it rises to 5.02; and for three or four indicators, it rises to 6.63 (see Table 6). Between 11 to 50 indicators, it rises to 10.83.[14] Beyond 50 indicators, the additional correction required rises rapidly, making it extremely unlikely that any indicator will clear the Bonferroni-corrected chi-square value.

The multiple comparisons problem indicates that there is a large statistical cost to testing more than a handful of indicators. More specifically, increasing the number of indicators tested raises the critical chi-square value, making it harder for an alternative indicator to demonstrate a significant association with the benchmark. To overcome this difficulty, we randomly split the sample into an "exploration" data set and a "confirmation" data set. The exploration data set contained 35 percent of the sample and was used to screen the more than 450 potential indicators[15] for use in a second round of statistical testing. To do this, the exploration data set was first used to create two-by-two contingency tables for each alternative indicator (Snedecor and Cochran 1989). Chi-square statistics indicating the strength of association between the benchmark and the alternative indicator were calculated. If the chi-square statistic for an indicator exceeded 3.84 (the critical value for significant association [$p < .05$] assuming a single comparison), then that indicator passed into the second round of testing. This initial screening was designed to decrease the number of indicators tested during the second round and therefore lessen the severity of the multiple comparisons problem.

Successful indicators were identified using two criteria. The first group of indicators, designated the "double winners," included indicators that demonstrated a chi-square statistic exceeding the critical value of 3.84 in both rounds of testing. A second group of winners, designated the "Bonferroni winners," included indicators that met stricter performance criteria. This group demonstrated a chi-square statistic greater than 3.84 in the screening round and a significant chi-square statistic using the Bonferroni adjustment in the second round. Results from both performance criteria are reported, as they illustrate the range of results that arepossible, given different requirements for indicator performance. While the group of double winners represents a group of indicators that succeeded under the least conservative criteria,

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[14] In actuality, an exact chi-square statistic can be calculated for each additional indicator. However, chi-square tables list critical values associated with incremental levels of probability. As such, we have reported the critical values that are associated with each range of probability levels reported in the chi-square table shown in Rossner (1995).

[15] For analyses of the chronic indicators of food insecurity, 450 indicators are tested for each season, leading to over 1,300 indicators.

Table 6 The relationship between the number of indicators tested and the critical chi-square statistic needed to determine a significant relationship between the alternative indicator and the benchmark

Number of Indicators Tested	Critical Chi-Square Value Using the Bonferroni Adjustment
1	3.84
2	5.02
3 to 5	6.63
6 to 9	7.88
10 to 50	10.83
above 50	rises to infinity

the Bonferroni winners represent the group that succeeded under the most conservative criteria; the double-winner group no doubt includes some indicators that are random winners, while the Bonferroni group no doubt excludes indicators that are truly useful.

A QUANTITATIVE ASSESSMENT OF THE PERFORMANCE OF THE ALTERNATIVE INDICATORS

A quantitative assessment of the performance of the alternative indicators is summarized in the tables below. Each table reports the results of the statistical tests of association between the core set of alternative indicators and one of the six benchmark indicators of food insecurity: (1) chronic household food insecurity, (2) acute household food insecurity, (3) chronic preschooler food insecurity, (4) acute preschooler food insecurity, (5) household vitamin A insecurity, and (6) household iron insecurity. Since many indicators were tested, the performance of only selected indicators are shown. Each table reports the chi-square statistics for (1) indicators that passed the first screening test for significant association with the benchmark (chi-square > 3.84) and (2) indicators that are commonly collected in field surveys and are often used as proxies for low economic status.[16] The last two columns indicate whether the alternative indicator was successful according to the Bonferroni or double winner criteria.

[16] Among this group, we include per capita household expenditures, per capita household food expenditures, the share of the household budget spent on food, per capita area of agricultural land controlled by the household, per capita number of agricultural plots controlled by the household, per capita area of agricultural area cultivated, the dependency ratio (two formulations), and household size.

The results are somewhat surprising. Few indicators were identified as "successful," using even the less conservative criteria represented by the double winners. Even fewer successful indicators were identified in the household-level analyses and none were successful at the preschooler level. Very few indicators of vitamin A deficiency were identified and none were identified for iron deficiency. Below, we discuss the results for each benchmark analysis.

Chronic Household Food Insecurity

For this analysis, we defined a household to be chronically food insecure if caloric adequacy fell below 70 percent in four of six dietary visits during the entire study period.[17] The choice of 70 percent as the benchmark cutoff was based on a calculation of the energy required to sustain a minimum activity lifestyle.[18] Under this definition, approximately 32 percent of all households were chronically food-insecure.

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[17] The caloric adequacy measures are based on (1) the dietary assessment using the 24-hour recall method devised by NIN and (2) the recommended energy intakes for Indians (NIN 1993). NIN's 24-hour recall method requires that the weight of all ingredients used for each recipe consumed during the preceding 24-hour period be recorded. Nutrient conversion factors are used to convert food quantities into nutrient quantities. The total amount of each nutrient consumed by the household is obtained by summing the nutrient contribution by each ingredient identified during the diet survey, subtracting leftovers, food thrown away, and food given to pets, guests, and livestock.

To obtain a measure of dietary adequacy at the household level, the dietary requirement for each individual in the household is expressed in terms of "adult equivalents." The number of adult equivalents for an individual is the nutrient requirement (as determined by the individual's age, sex, physiological status, and activity level) divided by the requirement for a "reference person." Among the academic nutrition community in India, the reference person is usually taken to be a 60-kilogram man of moderate activity (ICMR 1994). Summing the total nutrient intake by the household and dividing it by number of adult equivalents gives a measure of household nutritional adequacy. This measure allows researchers to compare nutrient adequacies among households of different sizes and compositions.

[18] Seventy percent of the recommended energy intake for the "reference" person is chosen, since it represents the energy requirement necessary for a low activity existence. More specifically, we used estimates of energy requirements (ICMR 1994) and applied them to a pattern of activities that would represent a life of minimal activity, that is, energy needs beyond basic physiological demands (8 hours sleeping, 1 hour walking, and 15 hours of standing or sitting quietly). For this pattern of activity, we calculate a calorie requirement of 2,015 kilocalories per adult equivalent. In turn, 2,015 represents approximately 70 percent of the 2,875 kilocalories necessary to support the reference man. Seventy percent of the requirement for an adult equivalent is therefore chosen as the cutoff for food insecurity.

The results of the chronic household analyses are shown in Table 7. Several alternative indicators showed a strong association with the benchmark for chronic household food insecurity. None, however, showed a significant association with the benchmark in every season.

The indicators that showed the strongest performance (i.e., that met the Bonferroni criteria) came from the household food frequency questionnaire[19]; as such, they represent information about the frequency of consumption of various foods. A priori one would expect that certain foods would be more commonly consumed by food-insecure groups and other foods more commonly consumed by more food-secure groups. The results, however, run counter to this logic. First, most of the indicators that are successful in locating the food insecure represent "more frequent" consumption of high-income elasticity foods, such as fats, oils, nuts, sugar, wheat, and processed cereal foods (buns/bread).[20] A priori we would expect that food-secure families would be more likely to consume these foods than food-insecure families. Yet, only one dietary indicator appears to be consistent with economic theory; "infrequent consumption of meat" is statistically correlated with chronic food insecurity. In addition, most of these counterintuitive dietary indicators appear more successful at identifying the food insecure than those suggested by the conventional poverty literature (e.g., indicators representing household expenditures, demographics, landholdings, and caste).

Previous analyses of the dietary data are helpful for interpreting these counterintuitive results. More specifically, a recent study on dietary patterns split the sample by state (Maharashtra vs. Andhra Pradesh) and then calculated the calories (per adult equivalent) derived from different food sources (Chung and Bouis 1996). The results showed very different dietary patterns between the two states (Table 8). More specifically, the villages located in Maharashtra (Shirapur and Kanzara) consumed more energy from sorghum and wheat than the study villages located in Andhra Pradesh (Aurepalle and Dokur). In addition, households in the Maharashtran villages typically consumed more energy from fats, oils, nuts, and sugar.

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[19] Note that different questionnaires were administered that collected dietary information (see Table 4). The food frequency questionnaire inquired about the frequency with which certain foods were consumed. In contrast to the 24-hour dietary recall, no attempt was made to quantify the amounts consumed.

[20] "Frequent" consumption is a relative term. Respondents were asked to state how often they consumed a certain food (e.g., more than once daily, daily, two-to-three times a week, once a week, etc.). As with all indicators, the cutoff for each food varies according to the frequency of responses for that food. "More frequent" can therefore mean one time (e.g., festival foods), a week for foods that are rarely eaten, or >1 a day for foods that are eaten more often (e.g., rice).

Table 7 Performance of selected alternative indicators of chronic household food insecurity

Indicator	Exploration Data Set χ_1^2	Se_1+Sp_1	n_1	Confirmation Data Set χ_2^2	Se_2+Sp_2	n_2	Double Winner?	Bonferroni Winner?
Alternative indicators screened in First Round								
Household located in Shirapur	4.75	124	97	4.39	114	196	Yes	No
High number of preschoolers in household, r1	5.04	127	97	4.57	116	196	Yes	No
Infrequent consumption of meat, r2	11.96	139	96	11.90	126	195	Yes	Yes
Infrequent consumption of eggs, r2	7.94	133	96	2.78	114	195	No	No
Frequent consumption of wheat, r2	8.14	133	97	2.30	112	195	No	No
Frequent consumption of fats or oils, r2	6.96	132	96	18.44	133	195	Yes	Yes
Frequent consumption of sugar or jaggery, r2	6.38	131	97	14.23	129	195	Yes	Yes
Frequent consumption of sorghum, r2	5.11	128	96	14.76	131	195	Yes	Yes
Frequent consumption of tea with milk, r2	4.78	127	96	7.97	122	195	Yes	No
Frequent consumption of nuts, r2	4.80	125	97	3.73	114	195	No	No
Frequent consumption of wheat, r3	5.54	127	97	7.92	120	196	Yes	No
Frequent consumption of sugar, r3	4.54	126	97	21.06	136	196	Yes	Yes
Frequent consumption of fats or oils, r3	4.15	126	97	18.37	133	196	Yes	Yes
Frequent consumption of pearl millet, r3	4.75	124	97	2.73	88	196	Yes	No
Frequent consumption of buns/bread, r3	4.06	124	96	2.92	113	196	No	No
High number of chickens owned, r2	4.27	124	96	3.68	114	192	No	No
High percent of food consumed from gifts, r3	6.20	124	96	0.49	106	196	No	No
Other commonly cited indicators								
Low per capita total expenditures (mean of 3 rounds)	1.53	115	95	6.52	118	192	No	No
Low per capita food expenditures (mean of 3 rounds)	1.97	116	95	3.06	113	192	No	No
High food share of total expenditures (mean of 3 rounds)	3.07	120	95	5.07	116	191	No	No
Forward caste	12.46	55	97	0.00	101	196	No	No
Backward caste	1.05	44	97	0.12	103	196	No	No
Scheduled caste	6.35	75	97	0.36	95	196	No	No
High household size ® 1)	0.17	93	97	0.73	107	196	No	No
High dependency ratio 2 (r1): Number of preschoolers/total number in household	2.72	118	97	2.92	113	196	No	No
High dependency ratio 10 (r1): Total number in household/ (total number in household - number of disabled)	1.34	114	97	3.04	113	196	No	No
Low per capita area of agricultural plots controlled by household (mean of 3 rounds)	0.00	103	82	1.76	111	168	No	No
Low per capita sum of cultivated land (mean of 3 rounds)	0.00	100	83	0.01	112	170	No	No
Low per capita number of agricultural plots controlled by household (mean of 3 rounds)	0.09	103	61	1.76	100	123		

Se = Sensitivity
Sp = Specificity

The set of dietary indicators shown in Table 8 mirrors the dietary trends shown in Table 7. When taken together, the set of "successful" dietary indicators describe the Maharashtran diets relative to the Andhran diets; Maharashtran diets are higher in sorghum, wheat, oil, sugar, and nut consumption relative to the Andhran diets. As a result, we interpret the joint performance of these dietary indicators to be more representative of the location they represent rather than any causal pathway involving any one of these foods per se. In short, each significant food consumption variable is in effect acting as a proxy for a location or geographic indicator. The plausibility of the geographic indicators is supported by the performance of the "Shirapur village" indicator in identifying the chronically food insecure.

Aside from the Shirapur and food frequency indicators, the only other successful indicator was the number of preschoolers in the household. This indicator, however, only succeeded during one season, using the more liberal double-winner criteria. Given that the number of preschoolers is not expected to change drastically from round to round, it is doubtful that it is a robust indicator of chronic household food insecurity. The lack of robustness of a relatively "structural" indicator (one that is not expected to change in the short term) suggests that this double winner may, in fact, be a random winner in both rounds of testing.

Acute Household Food Insecurity

For this analysis, we focus on *abrupt changes* in household caloric adequacy. To construct a "benchmark" of acute household food insecurity, we identified households that plunged from a state of food security into a state of food insecurity. To do this, we defined two points between which we could assess the changes in food security status. In this region, seasonality varies among the villages, but the third round is a lean season for all (during this time, the rains have not yet begun and little work is available). As such, the period between round two (the post-rainy season) and round three (late summer, early kharif season) was a good time to assess acute changes in food security.

To construct a benchmark of acute household food security, we defined a household to be acutely food insecure if (1) its household caloric adequacy ratio drops below 70 percent between rounds two and three OR (2) its calorie adequacy ratio is already below 70 percent in round two and drops 10 percent or more in the subsequent round.[21] Indicators collected in the second round (the post-rainy season) were tested for their ability to predict a fall into food insecurity during the third round (late summer, early kharif season).

[21] Note that if the second criteria is not included in the definition, then households that had low caloric adequacies in Round 2 (i.e., below 70 percent) and drop even further would be classified as food secure.

Table 8 Energy sources by food source and location of village

Village/ Food Group	Energy Intakes Per Adult Equivalent Expenditure Tertile 1	2	3	All
	(kilocalories)			
Maharashtra villages				
Rice	53	83	96	77
Sorghum	946	1,092	1,047	1,028
Millets	18	1	13	11
Other cereals	407	257	307	324
Pulses	153	131	97	127
Milk products	30	55	72	52
Other vegetables	21	19	19	20
Fruits	12	9	7	9
Cooking ingredients	366	352	409	376
Meat	6	5	5	5
Green leafy vegetables	3	5	8	5
All cereals	1,424	1,433	1,463	1,440
Total All	2,014	2,008	2,081	2,034
Andhra Pradesh villages				
Rice	1,774	1,714	1,602	1,696
Sorghum	260	289	259	269
Millets	23	72	54	50
Other cereals	10	24	15	16
Pulses	40	45	51	45
Milk products	60	62	100	74
Other vegetables	25	26	27	26
Fruits	2	9	3	5
Cooking ingredients	140	154	192	162
Meat	8	11	10	10
Green leafy vegetables	2	2	1	2
All cereals	2,067	2,099	1,930	2,031
Total All	2,344	2,408	2,314	2,356

Source: Chung and Bouis (1996).

The results of the acute household analyses are shown in Table 9. Several alternative indicators showed a strong association with the benchmark of acute household food insecurity. Among the strong performers are the food frequency indicators representing frequent sugar, sorghum, fats and wheat consumption. As with the chronic indicators, we interpret the joint performance of these dietary indicators to be representative of the location they represent rather than any causal pathway involving any one of these foods per se. As explained earlier, we believe that each of these indicators acts effectively as a proxy for a location or geographic indicator.

In addition to the proposed geographic indicators, two other alternative indicators performed well. Both involved the acquisition of foods: households that consumed a high percentage of foods from gifts and households that obtained a high number of foods on a weekly basis. These findings reflect behavior that is consistent with our expectations of food-insecure households; households under stress consume foods from gifts (a local euphemism for a food loan or a handout) and obtain many foods on a weekly basis (ostensibly because wages are paid once a week in these villages). These findings are also consistent with accounts that came out of the ethnography. Food-insecure households often borrowed and loaned foods for short periods of time and bought food immediately on wage days. The fact that these indicators are predictive of households falling into food insecurity in the subsequent round indicates that coping strategies for households "on the brink" begin long before the household actually drops into acute food insecurity.

Chronic Preschooler-level Food Insecurity

For this analysis, we defined a preschooler as chronically food insecure (PCFIS) if the Z-score for height-for-age was below -3.0. This cutoff point corresponded to the bottom 30 percent of sample distribution for height-for-age. A high level of chronic preschooler food insecurity was evident in the study villages: 47 percent of the preschoolers in Kanzara were chronically food insecure, 37 percent in Dokur, 27 percent in Shirapur, and 20 percent in Aurepalle.

The results for these analyses are shown in Table 10. Most striking is the fact that no alternative indicators (at the household level) are successful at identifying the PCFIS. Two of the alternative dietary indicators (frequent consumption of oils in rounds one and two) were screened as potential indicators in the first round of testing, but appeared to be "random winners," since they failed to perform in the second round of testing. None of the more conventional poverty indicators performed well at identifying the PCFIS either.

Table 9 Performance of selected indicators of acute household food insecurity

Indicator	Exploration Data Set χ_1^2	Exploration Data Set Se_1+Sp_1	Exploration Data Set n_1	Confirmation Data Set χ_2^2	Confirmation Data Set Se_2+Sp_2	Confirmation Data Set n_2	Double Winner?	Bonferroni Winner?
Alternative indicators screened in First Round								
High percentage of food consumed from gifts, r2	5.50	126	97	4.92	118	193	Yes	No
High number of food consumed obtained on weekly basis, r2	4.08	124	97	8.33	124	194	Yes	Yes
Frequent nuts/oilseeds consumption, r2	8.22	133	97	1.38	110	196	No	No
Frequent tea with milk consumption, r2	6.17	131	96	9.29	127	196	Yes	Yes
Frequent sugar consumption, r2	5.60	129	96	14.10	133	196	Yes	Yes
Frequent sorghum consumption, r2	4.16	126	97	4.80	119	196	Yes	No
Frequent fats/oils consumption, r2	4.07	125	96	10.66	129	196	Yes	Yes
Frequent wheat consumption, r2	4.24	125	97	8.93	126	196	Yes	Yes
Lives in Shirapur (yes)	8.19	132	96	3.68	114	192	No	No
High dependency ratio 2, r2	5.46	125	97	0.54	107	197	No	No
High dependency ratio 5, r2	5.46	125	97	0.54	107	197	No	No
High percent preschoolers in household, r2	5.46	125	97	0.54	107	192	No	No
High value of food consumed as gifts, r2	5.49	126	97	3.04	115	194	No	No
Household has a high number of loans, r2	4.66	124	97	1.16	111	197	No	No
High number of foods consumed from gifts, r2	7.24	130	97	1.43	111	194	No	No
Other commonly cited indicators								
Low per capita total expenditures (mean of 3 rounds)	1.03	113	95	0.09	105	192	No	No
Low per capita food expenditures (mean of 3 rounds)	0.01	104	95	0.05	103	193	No	No
High food share of total expenditures (mean of 3 rounds)	4.30	124	95	0.01	102	191	No	No
Forward caste	4.75	125	97	0.39	106	197	No	No
Backward caste	0.62	88	97	1.87	87	197	No	No
Scheduled caste	1.54	87	97	0.63	107	197	No	No
High household size (r1)	1.91	83	97	0.02	102	197	No	No
High dependency ratio 2 (r1): Number of preschoolers/ total number in household	1.72	116	97	0.54	107	196	No	No
High dependency ratio 10 (r1): Total number in household/ (total number in household - number of disabled)	5.46	125	97	0.24	105	197	No	No
Low per capita area of agricultural plots controlled by household (mean of 3 rounds)	0.01	98	82	1.41	89	168	No	No
Low per capita sum of cultivated land (mean of 3 rounds)	3.69	72	61	1.75	86	123	No	No
Low per capita number of agricultural plots controlled by household (mean of 3 rounds)	0.03	95	83	0.00	98	170	No	No

Notes: Se = Sensitivity
Sp = Specificity
r1 = Round 1, late kharif season
r2 = Round 2, post-rainy season
r3 = Round 3, late summer/early kharif season

Table 10 Performance of selected alternative indicators of chronic preschooler food insecurity

Indicator	Exploration Data Set			Confirmation Data Set			Double Winner?	Bonferroni Winner?
	χ_1^2	Se_1+Sp_1	n_1	χ_2^2	Se_2+Sp_2	n_2		
Alternative indicators screened in First Round								
Frequent consumption of fats and oils by household, r1	5.34	123	122	1.58	109	239	No	No
Frequent consumption of fats and oils by household, r2	5.66	126	115	1.02	108	225	No	No
Household has more than one income source (yes), r1	4.54	122	122	0.13	103	241	No	No
High number of household members engaged in a caste occupation (yes), r2	4.17	117	119	0.14	2	139	No	No
High number of household members engaged in a caste occupation (yes), r3	3.92	116	114	0.05	102	134	No	No
Low number of foods purchased per fortnight, r1	6.93	124	122	0.66	94	240	No	No
High percent of foods consumed from stocks, r2	9.57	128	118	0.26	104	234	No	No
Low number of foods purchased per week, r2	5.30	122	118	0.23	103	236	No	No
Low number of nonfoods purchased per year, r1	7.88	125	122	0.09	103	239	No	No
Household gave gifts, r2	4.39			0.00				
Low number of nonfoods purchased per week, r1	5.59	122	122	0.12	97	239	No	No
Household does not have a vegetable garden, r1	5.73	118	122	0.02	102	241	No	No
Household does not have a vegetable garden, r2	4.16	115	118	0.32	104	234	No	No
Low number of kind loans given out, last month, r1	5.72	118	122	0.02	101	239	No	No
Did not give gifts in r2	6.63	127	119	0.06	103	234	No	No
Other commonly cited indicators (household level)								
Low per capita total expenditures (mean of 3 rounds)	0.21	106	112	0.67	93	233	No	No
Low per capita food expenditures (mean of 3 rounds)	0.00	98	112	3.31	112	225	No	No
High food share of total expenditures (mean of 3 rounds)	0.00	101	112	0.00	99	227	No	No
Forward caste	0.02	103	122	1.70	92	243	No	No
Backward caste	0.10	95	122	0.07	103	243	No	No
Scheduled caste	0.00	102	122	0.75	106	243	No	No
High household size (r1)	0.09	104	122	0.00	101	241	No	No
High dependency ratio 2 (r1): Number of preschoolers/ total number in household	2.46	85	122	0.59	94	241	No	No
High dependency ratio 10 (r1): Total number in household/(total number in household - number of disabled)	0.02	103	122	0.35	105	241	No	No
Low per capita area of agricultural plots controlled by household (mean of 3 rounds)	0.58	110	92	0.08	97	203	No	No
Low per capita sum of cultivated land (mean of 3 rounds)	1.13	116	65	0.01	99	142	No	No
Low per capita number of agricultural plots controlled by household (mean of 3 rounds)	0.35	92	92	0.69	107	203	No	No

Notes: Se = Sensitivity
Sp = Specificity
r1 = Round 1, late kharif season
r2 = Round 2, post-rainy season

Acute Preschooler Food Insecurity

We defined a preschooler to be acutely food insecure (PAFIS) if he/she is among the worst 30 percent of preschoolers in terms of a drop in Z-score weight-for-height between rounds 2 and 3. This drop corresponds to a difference of .4 in the weight-for-height Z-score.

The same set of core alternative indicators were tested for their association with PAFIS. Again, as with the chronic preschooler analysis, no alternative indicators could be found that significantly predicted the specified drop in weight-for-height between rounds 2 and 3 (see Table 11). In addition, none of the more conventional poverty indicators performed well at identifying the food insecure.

Household Micronutrient Insecurity

This section discusses the indicators for identifying households with women or preschoolers with vitamin A and iron deficiencies. For these analyses, the "benchmarks" of micronutrient adequacy are based on serum measurements of vitamin A and hemoglobin. Samples were collected from preschoolers and women in Shirapur and Aurepalle villages in two different seasons.[22] Because our aim was to identify households with vitamin A and iron deficient preschoolers or women, households without preschoolers or women of reproductive age were excluded from these analyses.

Tables 12 and 13 provide an overall picture of vitamin A and iron status in the study area. Mean levels of serum vitamin A are shown in Table 12. For women, there is a significant decline in serum vitamin A between the late kharif season (round 1) and the late summer season (round 3). There is no significant difference between the villages in the incidence of vitamin A deficiency of preschoolers or women.

Table 13, however, shows that iron deficiency is clearly a serious problem in both Aurepalle and Shirapur.[23] In Aurepalle, over 60 percent of preschoolers fall below the WHO cutoff for anemia in both rounds. For women, only 47 percent were anemic in the first round, but iron status fell in the third round, leaving 75 percent of the women sampled anemic. In

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[22] All preschoolers in each study household were tested for hemoglobin and serum vitamin A. One woman of reproductive age, preferably the mother of the preschooler(s), was tested from each household.

[23] Iron deficiency was assessed with measures of hemoglobin. Hemoglobin concentration is one of the most widely used methods to screen for iron deficiency anemia. Hemoglobin, however, is technically an indicator of anemia, of which iron deficiency is one major cause. Low values of hemoglobin are associated with hypochromia, a characteristic feature of iron deficiency anemia.

Table 11 Performance of selected indicators of acute preschooler food insecurity

Indicator	Exploration Data Set χ_1^2	Exploration Data Set Se_1+Sp_1	Exploration Data Set n_1	Confirmation Data Set χ_2^2	Confirmation Data Set Se_2+Sp_2	Confirmation Data Set n_2	Double Winner?	Bonferroni Winner?
Alternative indicators screened in first round testing								
Household did not give gifts, r2	5.29	130	75	5.49	122	153	Yes	No
Household did not give cash transfers, r2	6.68	134	75	1.31	112	153	No	No
Low number not able to work, r2	7.95	134	75	0.29	106	154	No	No
Low number dependency ratio #7, r2	8.61	132	75	1.50	111	154	No	No
Low number dependency ratio #1, r2	5.67	130	75	0.92	109	154	No	No
Low number dependency ratio #4, r2	5.48	126	75	0.93	109	154	No	No
Low number dependency ratio #8, r2	4.37	124	???	1.27	113	154	No	No
Low number dependency ratio #10, r2	4.00	112	75	1.07	110	154	No	No
Low number dependency ratio #3, r2	4.00	122	75	1.07	110	154	No	No
Low number dependency ratio #9, r2	4.00	122	75	0.09	104	154	No	No
Number of agricultural workers	5.84	132	75	1.77	117	91	No	No
Other commonly cited indicators								
Low per capita total expenditures (mean of 3 rounds)	0.00	97	74	0.64	108	149	No	No
Low per capita food expenditures (mean of 3 rounds)	1.71	83	74	0.03	103	149	No	No
High food share of total expenditures (mean of 3 rounds)	0.17	107	74	0.04	97	149	No	No
Forward caste	0.36	85	75	0.02	97	154	No	No
Backward caste	2.09	120	75	2.34	115	154	No	No
Scheduled caste	0.05	95	75	2.72	88	154	No	No
High household size, (r2)	1.06	87	75	4.12	80	97	No	No
High dependency ratio 2 (r2): Number of preschoolers/ total number in household	3.06	120	75	3.24	116	136	No	No
High dependency ratio 10 (r2): Total number in household/(total in household – number of disabled)	4.01	122	75	1.07	110	97	No	No
Low per capita area of agricultural plots controlled by household (mean of 3 rounds)	0.07	99	75	1.08	90	154	No	No
Low per capita sum of cultivated land (mean of 3 rounds)	0.20	87	75	0.00	102	154	No	No
Low per capita number of agricultural plots controlled by household (mean of 3 rounds)	0.33	112	75	0.66	91	154	No	No

Notes: Se = Sensitivity
Sp = Specificity
r1 = Round 1, late kharif season
r2 = Round 2, post-rainy season

Table 12 Mean serum vitamin A (ug/dL) and percentage below NHANES II cutoffs[a] by season, age group and village

Village	Round 1: Late Kharif Season				Round 3: Late Summer Season			
	Mean	Standard Deviation	Percentage Below Cutoff	N	Mean	Standard Deviation	Percentage Below Cutoff	N
Aurepalle								
Preschoolers	29.5[b]	13.3	20.0	50	31.1[b]	13.6	11.7	60
Women	41.3[d]	15.1	4.8	62	35.4[dc]	10.3	4.2	48
Shirapur								
Preschoolers	22.6[b]	8.0	50.0	34	24.4[b]	7.5	28.6	49
Women	34.3[d]	12.3	11.1	54	28.8[dc]	10.1	14.0	43

[a] Pilch (1985).
[b] Significant difference in preschoolers' serum vitamin A values in Aurepalle and Shirapur.
[c] Significant difference in women's serum vitamin A values in Aurepalle and Shirapur.
[d] Significant decline in serum vitamin A values between seasons.

Table 13 Mean blood hemoglobin (g/dL) with percentage below WHO cutoffs[a] for anemia by season, age group and village

Village	Round 1: Late Kharif Season				Round 3: Late Summer Season			
	Mean	Standard Deviation	Percentage Below Cutoff	N	Mean	Standard Deviation	Percentage Below Cutoff	N
Aurepalle								
Preschoolers	10.1	1.8	68.0	50	10.5	1.5	63.3	60
Women	11.9	1.4	46.8	62	11.3[b]	1.4	75.0	48
Shirapur								
Preschoolers	10.7[c]	1.3	64.7	34	9.6[c]	1.8	83.7	49
Women	11.4[c]	1.9	57.4	54	10.2[cb]	1.6	81.4	43

[a] World Health Organization (1972).
[b] Significant difference between blood hemoglobin levels in Aurepalle and Shirapur.
[c] Significant decline in blood hemoglobin values between seasons.

Shirapur, anemia values also rose during the third round. In the first round, 57 percent of the women were anemic and, by the third round, 81 percent were anemic. Preschooler values followed a similar trend: 65 percent were anemic in the first round, worsening to 84 percent in the third round.

These high rates of anemia and vitamin A deficiency are characteristic of these parts of South Asia (ACC/SCN 1992). As such, food aid programmers may be interested in identifying households with micronutrient deficiencies. However, programmers may be hindered by their capacity to collect individual-level measurements. To address this constraint, the micronutrient indicator analyses focuses on testing the association between the core set of alternative indicators and two different micronutrient benchmarks, both which are defined at the household level. Separate analyses were undertaken for each micronutrient in each season. For the vitamin A work, a household is considered vitamin A-insecure if at least one woman or preschooler in the household falls below the WHO cutoffs. A similar benchmark indicator is derived for household iron security. Households are considered to be iron-insecure if at least one woman or preschooler in the household falls below the NHANES II cutoff (Pilch 1985).

Constructing micronutrient indicators at the household level is a novel idea, particularly since individual serum measurements are already available. This strategy, however, is consistent with the spirit of testing simple protocols for identifying targeting instruments. If successful, these analyses could provide a basis for less complicated data collection protocols by targeting agencies.

Vitamin A Deficiency. The results for the late-kharif season analyses (round one) are shown in Table 14 and those for the late-summer season (round three) are shown in Table 15. For each analysis, the benchmark for vitamin A insecurity was a simple dummy variable indicating whether a household contained at least one woman or preschooler that was deficient in vitamin A during that round (as determined by the NHANES II cutoffs) (Pilch 1985).

For the late kharif-season, a number of alternative variables screened into the second round of testing (Table 14). Many of them were indicators from the food frequency questionnaire. Most of them, however, did not perform well in the second round of testing. Only one of the screened indicators qualified as a double winner: household with a high number of preschoolers.

For the late-summer season (round three), very few alternative indicators screened into the second round of testing (Table 15). Only two alternative indicators qualified as double winners: households with a high number of preschoolers and households that had at least one preschooler with diarrhea during the last 14 days. Of these two, only the latter qualified as a Bonferroni winner.

Table 14 Performance of selected alternative indicators of vitamin A insecurity, round 1, late kharif season

Indicator	Exploration Data Set			Confirmation Data Set			Double Winner?	Bonferroni Winner?
	χ_1^2	Se_1+Sp_1	n_1	χ_2^2	Se_2+Sp_2	n_2		
Alternative indicators screened in first round testing								
Frequent consumption of nuts/oilseeds	8.31	148	45	2.47	124	75	No	No
Frequent consumption of rice	7.52	144	45	0.07	106	75	No	No
Frequent consumption of green leafy vegetables	7.52	144	45	0.43	112	75	No	No
Frequent consumption of sorghum	4.54	138	45	0.22	110	75	No	No
Frequent consumption of tea with milk	4.54	138	45	0.11	108	75	No	No
Frequent consumption of pulses	5.31	137	45	2.13	121	75	No	No
Number of preschoolers in household, (r1)	8.95	153	45	4.47	131	75	Yes	No
At least one preschooler sick with diarrhea in the last 14 days, r1	4.06	134	45	4.56	131	75	Yes	No
High dependency ratio #4, r1	10.01	151	45	2.13	121	75	No	No
High dependency ratio #7, r1	5.61	142	45	0.93	93	75	No	No
High dependency ratio #8, r1	4.78	478	45	0.93	93	75	No	No
Household lives in Shirapur	4.54	138	45	0.22	110	75	No	No
High number of foods consumed per week, r1	4.78	138	45	1.45	172	75	No	No
Did not give cash transfer last month, r1	6.55	146	45	0.99	117	75	No	No
Other commonly cited indicators								
Low per capita total expenditures (mean of 3 rounds)	0.80	118	43	0.73	86	70	No	No
Low per capita food expenditures (mean of 3 rounds)	0.80	118	43	0.04	94	71	No	No
High food share of total expenditures (mean of 3 rounds)	0.02	107	43	0.00	95	70	No	No
Forward caste	0.10	100	45	0.49	106	75	No	No
Backward caste	0.72	100	45	0.11	108	75	No	No
Scheduled caste	0.09	99	45	1.24	86	75	No	No
High household size, (r1)	0.32	114	45	1.06	106	75	No	No
High dependency ratio 2 (r1): Number of preschoolers/total number in household	3.04	131	45	0.43	112	75	No	No
High dependency ratio 10 (r1): Total number in household/(total number in household – number of disabled)	3.04	131	45	0.74	114	75	No	No
Low per capita area of agricultural plots controlled by household (mean of 3 rounds)	0.02	108	39	0.15	109	61	No	No
Low per capita sum of cultivated land (mean of 3 rounds)	0.00	107	28	0.09	110	46	No	No
Low per capita number of agricultural plots controlled by household (mean of 3 rounds)	3.58	134	39	0.02	102	61	No	No

Notes: Se = Sensitivity
Sp = Specificity
r1 = Round 1, late kharif season

Table 15 Performance of selected alternative indicators of vitamin A security, round 3, late summer, early kharif

Indicator	Exploration Data Set			Confirmation Data Set			Double Winner?	Bonferroni Winner?
	χ_1^2	Se_1+Sp_1	n_1	χ_2^2	Se_2+Sp_2	n_2		
Alternative indicators screened in first round testing								
Number of preschoolers in household, r3	3.89	143	44	3.89	130	71	Yes	No
At least 1 preschooler sick with diarrhea in the last 14 days, r3	4.56	141	43	8.23	139	71	Yes	No
High number of preschoolers, r3	4.47	143	44	3.88	130	71	Yes	No
Other commonly cited indicators								
Low per capita total expenditures (mean of 3 rounds)	0.14	101	42	0.24	90	68	No	No
Low per capita food expenditures (mean of 3 rounds)	0.14	86	42	0.19	91	68	No	No
High food share of total expenditures (mean of 3 rounds)	0.13	114	42	1.19	116	68	No	No
Forward caste	0.39	118	44	0.12	108	72	No	No
Backward caste	1.09	77	44	0.01	102	72	No	No
Scheduled caste	0.00	108	44	0.41	90	72	No	No
High household size, r3	0.91	124	44	0.13	116	71	No	No
High dependency ratio 2 (r3):Number of preschoolers/total number in household	0.47	119	44	0.13	116	71	No	No
High dependency ratio 10 (r3): Total number in household/(total number in household – number of disabled)	0.77	122	44	0.13	108	71	No	No
Low per capita area of agricultural plots controlled by household (mean of 3 rounds)	0.00	108	38	1.56	80	58	No	No
Low per capita sum of cultivated land (mean of 3 rounds)	0.18	96	28	0.81	82	45	No	No
Low per capita number of agricultural plots controlled by household (mean of 3 rounds)	0.03	95	38	0.09	100	58	No	No

Notes: Se = Sensitivity
Sp = Specificity
r3 = Round 3, late summer/early kharif season

Few indicators were produced from the vitamin A analyses. Yet the two suggested from these analyses are related to a plausible causal pathway. Households with more preschoolers, and households containing preschoolers with diarrhea, appear to be more likely to have vitamin A-deficient women and children. These indicators are logical given our knowledge of (1) the linkages between morbidity and vitamin A deficiency and (2) the competition for care and proper nourishment within households with many preschoolers. Note, however, that only the latter indicator (a more structural indicator) was robust across seasons. By contrast, the former indicator appears to be more season-specific. Given that sickness is more prevalent during the period following the rain, it is logical that the diarrhea indicator performs best during the late-kharif season (round 1).

Aside from these few successful alternative indicators, none of the more conventional poverty indicators performed well as a whole. None showed a significant association with the benchmark indicator of vitamin A insecurity.

Iron Deficiency. The high levels of anemia in the area suggest that it may not be necessary to target an iron-improvement program. However, under the assumption that intervention resources will always be limited, we explored the possibility of developing alternative indicators of iron deficiency. Again, because practitioners cannot always target at the individual level, we searched for household-level indicators that could identify households containing no iron deficient preschoolers or women of reproductive age. The benchmark for iron deficiency was a simple dummy variable, indicating whether the household contained at least a woman or preschooler that was iron deficient (as determined by the WHO anemia cutoffs) (WHO 1972).

The results for the analysis of alternative indicators for iron security for rounds 1 and 3 are shown in Tables 16 and 17, respectively. No successful indicators could be found for iron deficiency in either season.

HOW DO THE ALTERNATIVE INDICATORS SUGGESTED FROM THE QUALITATIVE WORK COMPARE TO THOSE DERIVED FROM THE QUANTITATIVE WORK?

The indicators tested in the quantitative analyses were derived from a review of the food security literature as well as our own qualitative work reported in Chapter 5. After completing both the qualitative and quantitative analyses, a logical question remained: how similar were the lists of successful indicators derived from each method? How did the indicators identified in the qualitative work perform in terms of their statistical association with the benchmark indicators? What did this mean for indicator development and use?

Since we wanted contemporaneous information from the qualitative and quantitative sections, the two data collections were launched simultaneously. However, doing so meant that

Table 16 Performance of selected alternative indicators of iron insecurity, round 1, late kharif season

Indicator	Exploration Data Set χ_1^2	Se_1+Sp_1	n_1	Confirmation Data Set χ_2^2	Se_2+Sp_2	n_2	Double Winner?	Bonferroni Winner?
Alternative indicators screened in first round testing								
High number of female preschoolers, r1	9.57	153	45	0.06	106	75	No	No
High number of females, r1	4.11	137	45	0.00	96	75	No	No
High dependency ratio #10, r1	3.91	133	45	1.03	86	75	No	No
High dependency ratio #3, r1	3.91	133	45	1.03	86	75	No	No
High dependency ratio #9, r1	3.91	133	45	1.03	86	75	No	No
High percent of persons incapable of work, r1	3.91	133	45	1.03	86	75	No	No
At least one child sick in past 14 days, r1	8.13	150	45	0.01	102	75	No	No
Number of sick children in past 7 days, r1	6.02	143	45	0.06	106	75	No	No
Commonly cited indicators								
Low per capita total expenditures (mean of 3 rounds)	0.06	98	43	0.78	87	70	No	No
Low per capita food expenditures (mean of 3 rounds)	0.06	98	43	3.67	75	71	No	No
High food share of total expenditures (mean of 3 rounds)	2.94	129	43	0.25	91	70	No	No
Forward caste	0.01	107	45	0.86	86	75	No	No
Backward caste	0.28	87	45	0.00	102	75	No	No
Scheduled caste	0.01	107	45	1.00	112	75	No	No
High household size, r1	2.81	130	45	0.22	108	75	No	No
High dependency ratio 2 (r1): Number of preschoolers/ total number in household	7.15	143	45	0.00	96	75	No	No
High dependency ratio 10 (r1): Total number in household/ (total number in household – number of disabled)	3.91	133	45	1.03	86	75	No	No
Low per capita area of agricultural plots controlled by household (mean of 3 rounds)	0.78	119	39	1.00	85	50	No	No
Low per capita sum of cultivated land (mean of 3 rounds)	0.00	109	28	0.02	94	61	No	No
Low per capita number of agricultural plots (mean of 3 rounds)	0.76	119	28	0.06	99	46	No	No

Notes: Se = Sensitivity
Sp = Specificity
r1 = Round 1, late kharif season

Table 17 Performance of selected alternative indicators of iron insecurity, round 3, late summer, early kharif

Indicator	Exploration Data Set χ_1^2	Se_1+Sp_1	n_1	Confirmation Data Set χ_2^2	Se_2+Sp_2	n_2	Double Winner?	Bonferroni Winner?
Alternative indicators screened in first round testing								
High number of chickens owned	9.63	159	44	0.25	116	70	No	No
Other Commonly Cited Indicators								
Low per capita total expenditures (mean of 3 rounds)	0.01	105	42	0.02	94	68	No	No
Low per capita food expenditures (mean of 3 rounds)	0.01	105	42	0.14	99	69	No	No
High food share of total expenditures (mean of 3 rounds)	0.85	121	42	0.97	127	68	No	No
Forward caste	0.09	101	44	0.09	98	72	No	No
Backward caste	0.02	91	44	0.02	95	72	No	No
Scheduled caste	0.00	107	44	0.00	106	72	No	No
High household size, r3	0.72	121	44	0.34	118	71	No	No
High dependency ratio 2 (r3): Number of preschoolers/total number in household	0.13	112	44	0.30	116	71	No	No
High dependency ratio 10 (r3): Total number in household/ (total number in household – number of disabled)	0.98	122	44	0.00	117	71	No	No
Low per capita area of agricultural plots controlled by household (mean of 3 rounds)	0.00	108	38	0.00	110	58	No	No
Low per capita sum of cultivated land (mean of 3 rounds)	0.23	100	28	0.03	108	45	No	No
Low per capita number of agricultural plots controlled by household (mean of 3 rounds)	0.51	121	38	0.06	96	58	No	No

Notes: Se = Sensitivity
Sp = Specificity
r1 = Round 1, late kharif season

it was not possible to use the information derived from the qualitative work to inform our survey design. As such, many indicators suggested by the qualitative work did not appear on the survey and could not be tested. Some of the "winners" from the qualitative work appeared coincidentally in the survey and we were able to test them quantitatively. These indicators are shown in Table 18.

However, of the indicators listed in Table 18 none were found to have a significant association with chronic household food insecurity. What does this lack of "overlap" between the qualitative and quantitative results mean?

Our primary explanation involves the fact that single indicators were tested in the quantitative analysis. In our qualitative work, however, villagers rarely identified a single reason for which a household was food insecure, but rather a number of reasons. During the qualitative exercises, the research team asked the villagers to identify the households that "constantly struggle to feed their members." They then probed for the reasons why these families were food insecure. In every case, the villagers named more than one reason why they thought the household struggled and, in most cases, it involved two or three reasons. Our ethnographic reports of families also suggested that it was a combination of factors rather than any single factor that predisposed a household toward chronic food insecurity. In short, more overlap might be found between the two sets of "successful" indicators if combinations of indicators were tested in the quantitative analysis. A logical way to investigate this idea would be to perform a stepwise logistic regression, using the core set of quantitative indicators. Once the stepwise was complete, we could compare the "set" of indicators to that derived in the qualitative results.

A second reason why there might have been little overlap between the qualitative and quantitative results involves the fact that relatively few successful indicators were identified in the quantitative study. The low number of identified indicators might at first indicate that there is little potential for alternative indicators or, at least, for indicators used singly. However, further statistical tests indicate that most of the statistical tests of indicators reflected relatively low statistical power at the sample sizes tested. The implication of low power in a hypothesis testing situation is that a statistical test may not reject the null hypothesis (i.e., may not find a statistical association between an alternative indicator and the benchmark) when, in fact, it should. In short, a statistical test conducted under conditions of low power may not identify an alternative indicator as being successful when it truly is.

Power calculations for each one of our two-by-two contingency tables indicate that a vast majority of the chi-square tests were conducted under conditions of low power. The implications of this are clear: We can be relatively sure that the indicators that are identified as "winners" are indeed good indicators of the benchmarks. However, we cannot be sure that

Table 18 Indicators suggested by the Qualitative work that appeared in the survey and were tested using quantitative performance criteria

Indicators of Household Chronic Food Insecurity Identified by Qualitative Techniques (Reported in Chapter Five)	Corresponding Indicator from the Survey, Tested Quantitatively in this Chapter
Poor quality land	Number of irrigated plots
Landless	Landless
Distress sales of livestock	Sold large livestock (since last round)? Sold medium livestock (since last round)? Sold small livestock (since last round)?
Distress sales of other valued assets	Sold jewelry (since last round)? Sold house (since last round)? Sold land (since last round)?
High number of loans from informal sources	Number of informal loans
Permanent Laborers	Household has a permanent laborer
Few Income earners in a large family	Dependency ratio (10 formulations)
Purchase staple grains on a more-than-once-a-week basis	Purchases grain more than once a week
Heavy reliance on wage work	Number of members that are casual laborers Number of members that are agricultural laborers

"losers" identified by the same process are truly "losers." Rather, under conditions of larger sample sizes, significant associations may have been found.

As a result, we can say very little about the overlap between results generated using qualitative and quantitative results, since our quantitative results most likely *understate* the number of statistically valid alternative indicators. We *do* know, however, that future analyses must consider the potential for combinations of alternative indicators and that they must use sample sizes that make it more likely that statistically significant alternative indicators are identified.

THE BENEFITS OF TARGETING

In this section, we undertake a number of simulations to illustrate the benefits of using targeting indicators. Note, however, that the benefits associated with an indicator will vary according to how it is used to improve the cost-effectiveness of the program. As such, evaluating the effectiveness of any given indicator requires a specification of the conditions and context in which it will be used.

Consider, for example, three different scenarios under which targeting might be used to improve the efficiency of a program:

1. *A fixed-budget scenario*: Under this situation, programmers have a fixed budget and can serve a fixed number of participants. Targeting is used to increase the proportion (and hence absolute number) of truly food-insecure households participating in a program. The total budget of the program remains fixed, but, relative to the untargeted situation, the total number of truly food-secure participants rises;
2. *A fixed-coverage scenario*: Under this situation, programmers use targeting to decrease the total number of participants in the program while still serving the same number of households that are truly food insecure. Relative to an untargeted program, the total budget of the program decreases, although the total number of truly food-insecure households that are served remains the same.
3. *A variable-benefits scenario*: Under this scenario, programmers use targeting to serve the same number of food-insecure households as in an untargeted intervention, but they increase the value of goods or services provided to each participant. There is no increase in the overall budget, but the benefit to each food-insecure household rises.

When is it worthwhile to target? In general, if the prevalence of food insecurity is very high, program leakage in an untargeted program will be fairly small. In this case, most participants will be truly needy and efforts to improve targeting are likely to have a marginal

benefit. Since there are non-zero costs associated with collecting and acting on targeting data, it is possible for a targeted program to be less cost-effective than an untargeted program.

On the other hand, when the prevalence of food insecurity is relatively low or there is a particular interest in serving only a small number of the most food insecure in a population, then targeting indicators may be particularly useful. In this case, an untargeted program would be likely to have a high proportion of participants who are not truly food insecure and, therefore, a high degree of program leakage. In general, as the prevalence of food insecurity declines (or the concern for the most disadvantaged participants increases), the leakage of benefits to those who are not truly food insecure is likely to increase in an untargeted program. In these cases, the use of targeting indicators may be quite powerful in reducing program costs and maximizing its social impact.

Illustrating the Use of Targeting Indicators to Reduce Program Leakage

In this section, each of the indicators identified as "double winners" in the quantitative analysis are used to illustrate the potential reductions in program leakage that may be achieved with targeting. Table 19 presents this analysis as a comparison of the benefits of targeting using alternative indicators with the untargeted case, under both the fixed budget and fixed coverage scenarios.[24] The budgetary implications of targeting are assessed, given assumptions of per capita intervention costs of US$10 and a program size of 100,000 participants.

Consider first the fixed-budget scenario. Column 1 of Table 19 shows the percent increase in the number of true positives included in the program (i.e., truly food-insecure participants) as a result of using a targeting indicator. Column 2 shows the percent reduction in the leakage costs after a targeting indicator has been used. This value represents the decrease in misallocated program resources once the program has been targeted with an alternative indicator. Note that these calculations include only program costs; no provision is made in this analysis for the social benefits associated with decreasing food insecurity, a subject which will be treated in more detail in the section below.

Under the assumption of a fixed program budget, the results from Table 19 show that targeting with selected alternative indicators increases the number of true positives in the hypothetical program by as much as 26 percent in the case of the indicators of acute preschooler food insecurity and by as much as 97 percent in the case of vitamin A deficiency (based on data from round 1). Given the relatively low prevalence of vitamin A deficiency in the population (28 percent) and the resulting high potential leakage from an untargeted

[24] Because the variable benefits scenario is similar to the fixed budget scenario in terms of its impact on program leakage, an analysis for this scenario is not presented in Table 19.

Table 19 The benefits from targeting with selected indicators, compared to no targeting

Indicator	Fixed Budget Scenario: Percentage Increase in True Positives	Fixed Budget Scenario: Percentage Reduction in Leakage Costs	Fixed Coverage Scenario: Percentage Reduction in Budget	Fixed Coverage Scenario: Minimum Difference in Data Costs to Equate Net Savings[a]
Chronic Household Food Insecurity				
Households located in Shirapur	36.6	18.6	26.8	68,467
High number of preschoolers	31.0	15.7	23.7	99,700
Infrequent consumption of meat, r2	50.7	25.7	33.6	0
Frequent consumption of fats/oils, r2	37.1	18.8	27.0	66,026
Frequent consumption of sugar, r2	33.1	16.8	24.9	87,612
Frequent consumption of sorghum, r2	42.2	21.4	29.7	39,836
Frequent consumption of sugar, r3	44.2	22.5	30.7	29,712
Frequent consumption of fat, r3	41.4	21.0	29.3	43,577
Acute Household Food Insecurity				
High percentage of food consumed from gifts	55.7	16.0	35.8	30,007
High number of foods consumed weekly	63.4	18.0	38.8	0
Frequent tea with milk consumption, r2	42.6	12.2	29.9	88,983
Frequent consumption of sugar, r2	47.0	13.5	32.0	67,945
Frequent fat/oil consumption, r2	40.7	11.7	28.9	98,370
Frequent wheat consumption, r2	60.3	17.3	37.6	11,659
Acute Preschooler Food Insecurity				
Household did not give gifts, r2	26.3	10.3	20.8	n.a.
Vitamin A Deficiency (round 1)				
Number of preschoolers	57.9	19.6	36.7	126,667
Preschoolers with diarrhea	97.4	33.0	49.3	0
Vitamin A Deficiency (round 2)				
Number of preschoolers	80.1	20.6	44.5	44,311
Preschoolers with diarrhea	95.7	35.0	48.9	0

[a] Based on given assumptions of program size and cost structure and relative to the indicator that is found to produce the greatest reduction in the program budget.

n.a. = not applicable.

program, the results suggest that large returns may be possible from targeting on the selected indicators. These returns are the result of improved coverage of the truly food insecure.

The fixed-budget scenario also suggests potentially large reductions in the costs of program leakage. Table 19 indicates that under the given set of assumptions, leakage costs may be reduced by as much as 35 percent, as in the case of alternative indicators of vitamin A deficiency.

Columns 3 and 4 of Table 19 illustrate the fixed-coverage scenario. In this scenario, targeting indicators are used to reduce the number of program participants who are not truly food insecure and, thereby, reduce the program's overall budget. Through a reduction in the overall size of the program, as reported in column 3, targeting can result in program savings of between 21 percent (in the case of acute preschooler food insecurity) and 49 percent (in the case of vitamin A deficiency, round 1).

Given this set of program conditions, the results in Table 19 suggest that certain indicators can out-perform others in reducing program leakage. Recall, however, that the correct criteria for selecting targeting indicators is the size of the program savings *net of data collection costs*. The fourth column in Table 19 illustrates how data collection costs might inform the choice of one indicator over another. This column shows the minimum difference in data collection costs that would allow the indicator to be more cost-effective than the most successful indicator for each benchmark analysis (i.e., the indicator that provides the highest program savings for each benchmark analysis).

Consider the case of chronic household food insecurity. In this simulation, the indicator of "infrequent meat consumption" resulted in the greatest total reduction in program costs across all the alternative "double winners" tested. Using this indicator, program savings were 33.6 percent of the assumed budget of US$1 million, or US$336,435 (see column 3 of Table 19) . The next greatest reduction in program costs are obtained by targeting on the indicator "frequent consumption of sugar (r3)." Targeting with this indicator results in a savings of nearly 31 percent, or US$306,723. Column 4 shows the minimum difference in data costs that would equate the savings achieved using the two indicators (i.e., that would make us indifferent between the two indicators). For this case, the difference is $29,712. This indicates that the savings achieved using the sugar variable would be greater than the meat variable, as long as the sugar variable costs at least $29,712 less to collect. After this point, the meat variable is more cost-efficient.

If, however, the cost of collecting the two indicators were equal, then the "infrequent consumption of meat (r2)" indicator would always be preferred for targeting programs designed to address chronic household food insecurity. Column 4 contains similar comparisons for all the alternative "double winners" identified in the study. For example, the "frequent consumption of

sorghum (r2)" indicator would be preferred only if the costs of data collection were at least US$39,836 less than that of the meat consumption indicator.

These examples are presented to underscore the fact that the appropriate criterion for indicator selection is savings *net of data collection costs.* Note, however, that the results in column 4 are artifacts of the assumptions regarding program size and costs that were adopted for this particular scenario. Varying the assumptions and matching them to the actual cost structure of a program is likely to change the relative performance of these indicators and the ultimate choice of the optimal indicator to use for targeting purposes.

Accounting for the Social Cost of Food Insecurity

The results in the previous section describe how targeting can reduce program leakage and thus decrease program costs. These analyses, however, are silent on the issue of social costs. Ideally, the choice of a targeting indicator should account for an indicator's ability to minimize the social cost of food insecurity. More specifically, food aid programmers would choose indicators that minimize the program and social costs, net of data costs.

Although it is difficult to determine a value for the social cost of food insecurity, it is possible to identify a range of social costs over which one indicator might out-perform another. In this case, selecting an indicator boils down to determining whether a given range of social costs for one indicator is more realistic than those associated with another indicator.[25] This assessment is not straightforward and it may not be always possible to identify a single-best indicator for targeting purposes. It may be possible, however, to identify a set of preferred indicators. An indicator in this preferred set can produce significant reductions in program and social costs relative to the untargeted case.

To illustrate how the social costs of food insecurity might enter into the selection of a targeting indicator, we undertake a targeting simulation (see Table 20). For this exercise, we must make assumptions about the program, considering the targeting variables. We will assume a program size, a per capita intervention cost, and the cost of collecting each alternative indicator.[26] In this example, programmers are seeking an alternative indicator to identify chronically food-insecure households. The exercise assumes a program with a population of

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[25] Note that It is possible to control for social costs by comparing the performance of indicators at varying cutoffs that equate the number of false negatives produced by each indicator. In this case, the social costs of food insecurity are equal for each indicator and comparisons of indicator performance can be made solely on the basis of program costs. The reasons for presenting a comparison of indicators at a fixed cutoff are presented in Section 3.

[26] The same analysis may be done on an actual program if these figures are available.

Table 20 Accounting for the social costs of food insecurity in assessing indicator performance (numbers in 000s)

	Program Costs (1)	Social Costs of False Negatives (2)	Subtotal (1+2)	Reduction in Program and Social Costs from Targeting	Data Costs Which Equate Net Savings[a]	Savings Net of Data Costs
Chronic Household Food Insecurity						
Scenario 1 (social cost=US$10.00/capita)						
No targeting	1,000	1,347	2,347	...	0	0
Live in Shirapur	1,000	1,224	2,224	123	61	62
No preschoolers	1,000	1,243	2,242	104	42	62
Infrequent meat (round 2)	1,000	1,185	2,185	162	100	62
Fats/oils (round 2)	1,000	1,231	2,231	116	54	62
Sugar (round 2)	1,000	1,244	2,244	103	41	62
Sorghum (round 2)	1,000	1,214	2,214	133	71	62
Sugar (round 3)	1,000	1,197	2,198	149	87	62
Fat (round 3)	1,000	1,207	2,207	139	77	62
Scenario 2 (social cost=US$76.25/capita)						
No targeting	1,000	10,271	11,271	...	0	0
Live in Shirapur	1,000	9,331	10,331	940	-196	1,136
No preschoolers	1,000	9,474	10,474	796	-340	1,136
Infrequent meat (round 2)	1,000	9,035	10,035	1,236	100	1,136
Fats/oils (round 2)	1,000	9,385	10,385	886	-250	1,136
Sugar (round 2)	1,000	9,486	10,486	785	-351	1,136
Sorghum (round 2)	1,000	9,254	10,254	1,017	-119	1,136
Sugar (round 3)	1,000	9,135	10,135	1,136	0	1,136
Fat (round 3)	1,000	9,207	10,207	1,063	-73	1,136
Acute Preschooler Food Insecurity						
Scenario 3 (social cost=US$10 per capita)						
No targeting	1,000	1,124	2,124	...	0	0
Perfect targeting	1,000	405	1,405	719	200	519
No gifts made	1,000	1,050	2,050	74	-445	519

[a] Based on assumed data collection costs for the indicator that produces the greatest gross total savings in each scenario.

... = Not applicable.

500,000, in which budgetary resources are sufficient for 100,000 people to actually participate in the program. The per capita intervention cost is again assumed to be US$10. Two scenarios are shown. Scenario 1 presents an analysis of indicator performance under the assumption that the per capita social costs of food insecurity are equal to the per capita costs of the intervention. This is a lower-bound scenario, since it is unlikely that any intervention would spend more to resolve a food security problem than the problem was actually worth to society.

In this lower-bound scenario, we first consider the indicator that provided the greatest total savings (social plus program costs), as indicated in column 4 of Table 20. This is, again, the "infrequent meat consumption" indicator. Because program costs are fixed, the savings from targeting are derived from the increased proportion of the food insecure who are served by the program and, thus, the reduction in the social costs of food insecurity (the costs associated with false negatives). As indicated in Column 3, total social plus program costs of a program targeted using the infrequent meat consumption indicator amounts to US$2,185,000 under the stated assumptions. Compared to the costs in an untargeted program of US$2,347,000, the use of the infrequent meat consumption indicator implies a total savings of US$162,000, by far the highest savings of all the candidate indicators listed in the table.

Assuming that the cost of collecting information on the frequency of meat consumption is equal to US$100,000, the net savings from targeting using this indicator is US$62,000. Given that assumption, column 5 of Table 20 provides the data collection costs for the other alternative indicators necessary to equate the net savings from targeting with that of the meat consumption indicator. The analysis shows that at the lower-bound estimate of the social costs (US$10 per capita), the "consumes fats and oils frequently" indicator can out-perform the meat consumption indicator only if it costs less than US$54,000 to collect. Similarly, the "frequent consumption of sugar" indicator could outperform the meat consumption indicator only if data collection costs are less than US$87,000.

Scenario 2 attempts to identify whether there is a level of per capita social costs of food insecurity such that no indicator can possibly out-perform the "infrequent meat consumption" indicator. The results show that the social costs of food insecurity would have to rise only to a level of US$76.25 per capita to clearly identify meat consumption frequency as the optimal targeting indicator.[27] At this level, column 3 suggests that the savings (in terms of both program

[27] The figure of US$76.25 was derived using an iterative process that attempts to set the social cost at a level such that the data collection costs of alternative indicators would have to be less than zero in order to out-perform the infrequent meat consumption indicator, in terms of net reduction in total program plus social costs. That level of social cost is sensitive not only to the sensitivity-specificity characteristics of each indicator, but also to the assumptions of program size, the cost of an intervention, and the US$100,000 data collection costs for the infrequent meat consumption indicator.

and social costs) from targeting on the meat consumption indicator would rise to US$1,236,000 compared to the no-targeting case. Again, the next greatest reduction in total costs could be obtained by targeting on the "frequent consumption of sugar (r3)" indicator, which would result in a savings of US$1,136,000. In this case, the difference in savings across the two indicators is US$100,000.

Under the assumption that data collection costs for the "infrequent consumption of meat" indicator are US$100,000, it is impossible for the "frequent sugar consumption" indicator or any other indicator to provide a greater net savings. To do so, given the various assumptions under this scenario, data collection costs for the sugar consumption indicator would have to be zero. In this example, if the per capita social costs of food insecurity were thought to be US$76.25 or higher, the "infrequent consumption of meat" would be the optimal indicator.

If it is determined that the social costs of food insecurity are lower than the critical value of US$76.25, then there may not be a clear choice of indicators. It is important to recognize, however, that there are still benefits to be derived from targeting on any of a number of indicators. Even under assumptions of minimum social costs described in Scenario 1, it is clear that a number of indicators can provide some degree of net savings and that the impact of targeting using any one indicator may still be positive.

Comparisons to "Perfect Targeting"

As stated previously, the use of the "gold standard" or benchmark indicator in selecting candidates for program participation represents a case of "perfect targeting."[28] The search for alternative indicators for targeting purposes is therefore justified only if the benchmark indicators of food insecurity are considered to be unreliable or too costly to use in an operational context. An indicator, for example, might be considered unreliable if it is subject to a strategic bias in the responses by those who perceive that some benefit might accrue to them if they misrepresent their personal information. Alternatively, the costs of collecting a "gold standard" indicator may be too high in the context of any given program to warrant its use as a screening tool.

In the latter case, where concerns are primarily cost-related, the performance of alternative indicators should be evaluated vis-à-vis the performance of the benchmark itself, in addition to comparisons to the no-targeting scenario. It is possible that, in spite of fairly high data collection costs, use of the benchmark indicator may still prove more cost-effective than any alternative.

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[28] Note that use of the term "perfect targeting" is not intended to deny the possibility of measurement error in the direct, benchmark indicator, only to imply that benchmark is presumably the best possible measure of the food security dimension of concern and the standard against which the performance of other indicators are compared. The results reported in Table 20 suggest that the benchmark indicator would likely be preferable to alternatives, even in the case of fairly significant measurement error.

Scenario 3 in Table 20 provides a comparison of the performance of an indicator that was technically successful at identifying preschoolers with acute food insecurity. The indicator, "household provided gifts to other households," is evaluated against the benchmark measure of child weight-for-height. The program assumptions are similar to those for the preceding scenarios: program size is 100,000, the cost of an intervention is US$10 per capita, and the social costs of food insecurity are also equal to US$10 per capita. In this scenario, the data collection costs of the benchmark (the perfect targeting case) is assumed to be US$200,000 (20 percent of the size of the program).

For this scenario, as indicated in the table, the potential savings from perfect targeting far outweigh the costs associated with collecting the benchmark indicator. The calculations shown indicate that there is no feasible value of social costs at which the alternative "gifts" indicator out-performs the gold standard indicator based on child anthropometry.[29] To do so, the data collection costs for the alternative indicator would have to be less than zero. Therefore, in this particular example, there would be no rationale for targeting on the basis of any alternative.

7. AN EVALUATION OF THE DATA COLLECTION PROCESS

An important component of this study is to understand the difficulties associated with each data collection method as well as the conditions that make each method feasible. During the data collection process the field investigators played a large role in informing our position on these issues. Day-to-day feedback from field investigators was encouraged and recorded as part of the research process. In addition, we organized a two-day conference in July 1993, in which we spent one full day gaining feedback from the data collection teams—both qualitative and quantitative—on a number of aspects that impinged on the reliability and accuracy of the data collected.

QUALITATIVE DATA COLLECTION

To what extent did the study find participation desirable, feasible, and practical? More specifically: (1) is the use of participatory research methods more empowering to respondents compared to traditional research methods, or does the use of participatory methods only

[29] Again, while the method presented is valid and applicable across a range of possible program contexts, it is important to note that the analysis is intended for illustrative purposes only. The specific results presented in Table 20 depend on assumptions of program size, per capita cost of intervention and data collection costs, as well as the per capita social cost of food insecurity.

empower the researchers?, and (2) can research can be designed to incorporate local knowledge, share information, let respondents benefit from our findings, and generally improve the quality of policy and program conclusions?

Did Participation Empower the Villagers?

Despite our best efforts, we have to conclude that the participatory research methods used in our study were no more empowering for the villagers than our survey methods. In this sense, the participatory methods we used are more accurately described as qualitative rather than truly participatory.

The participatory methods, however, did help to establish rapport with the villagers quickly. They were far more interactive than the survey, and lent themselves more naturally to a dialogue between respondents and researchers, rather than simple question and answer sessions. In addition, the villagers widely agreed that the participatory methods (they called them "games") were of more interest than the survey data collection methods. Most villagers appreciated the transparency of the visual representations, as well as the opportunity to express themselves creatively through group activities (such as the village map and the food charts).

While certain definitions were not always determined by local people (e.g., "energy expenditure" and "very high risk families"), the concepts needed for the project exercises were adapted for local needs. For example, the local way of expressing percentages in terms of the number of paise in a rupee was frequently used. Open-ended discussions allowed researchers to gain a better understanding of how emic (locally defined) perceptions differed from etic (defined by outsiders) ones. However, we felt that respondents still provided information on the researchers' terms, most often using the researchers' concepts expressed in local language. It is for these reasons that we feel that the methods we used were no more participatory than the survey methods employed. If there is a need to distinguish this type of data collection from the survey, they are more accurately described as qualitative rather than participatory.

In some instances, however, the potential for nutrition education, community monitoring, and community intervention was clear. The visual representations typical of participatory methods gave the villagers the opportunity to reflect on the facilities available in their neighborhoods, on the diversity of their diet, and the seasonality of village phenomena. Some villagers were astonished by their own food charts; they had not imagined they ate so many kinds of foods. Some spontaneously asked, "Are we eating OK? What should we eat?" These experiences indicate that participatory methods carry great potential for starting an educational dialogue on nutrition.

Feasibility: Problems with Participatory Approaches in the Context of Research

The participatory methods were not without their special problems. As these methods are meant to elicit participation in group discussions about village problems, they tend to raise expectations that the research group will initiate a village development program. Questions that seem simple in the office, such as "Who in this village is hungry?" were difficult to ask (let alone answer) in the field as they carried political and economic implications for the villagers.

Even when investigators made it clear that they were not initiating a development program, the perception that benefits might accrue to "the food insecure" created an incentive to misinform investigators and bias responses. For example, the potential for receiving benefits produced apprehension in some women's groups as to whether or not identify certain households as food insecure. This exercise often led to responses such as "Who isn't?" or "Everyone"!

During the participatory exercises we also faced the dilemma of facilitating the participation of different caste groups and women, while not alienating dominant groups. We found that this dilemma could be resolved to some extent by dealing separately with different sections of the village as divided on caste lines. Even within families, however, it was difficult to obtain equal participation of all members. In certain households, men insisted on overriding their wives' responses. In other households, mothers-in-law gave all the responses even though their daughters-in-law were the cooks.

We noted that participatory methods are not necessarily rapid. Time is needed for establishing rapport, playing with children, helping with chores, sensitivity in broaching confidential topics, and in encouraging responses from shy or reluctant villagers. We found that each household exercise took over an hour to complete (equal approximately to conducting a diet survey) and the group exercises took approximately 2.5 hours. However, participatory data are more transparent and less likely to require extensive computer entry and analysis.

The adaptation of participatory methods for research in the area of food security is relatively new. Our experiences indicate that the participatory methods are more flexible than survey methods, more respectful to local knowledge, and quicker for establishing rapport between investigators and villagers. Our participatory methods did not save us much time in the field, but did save time in data entry and analysis. In addition, our participatory methods provided us with a means of obtaining a broad overview of village-level phenomena in situations where the research team is new to a village.

Finally, it should be noted that the quality of the participatory exercises rely heavily on the skills of individuals facilitating the exercises. Staff members must have a keen understanding of the objectives of the participatory exercise and how to elicit this information from villagers. They must be able to think on their feet and probe for clarifying answers. Furthermore, to make the process truly participatory investigators must be given the opportunity to follow up research plans with action plans designed by the participants.

SURVEY DATA COLLECTION

At the July workshop, both teams of survey investigators—nutrition and economics were active participants. Much of this section summarizes their perceptions on data collection under the various survey modules.

• *Dietary Modules*

Three survey methods were used to discuss dietary patterns of the study households: 24-hour recall, food frequency, and food charts (on a subset of 40 households). These methods were compared, in a subjective manner, by the enumerators (see Table 21). While it is impossible to compare the methods in an objective fashion—the methods all have different purposes—we found tables such as the one below, which was constructed by the nutrition enumerators themselves, to be extremely useful in deciding which indicators we could trust and which we could not.

The most difficult families to survey with the 24-hour recall methods were the better-off families who claimed they had no time to complete the questionnaire, tended to give food away, and consumed a wide variety of foods), and the extended families which had complicated eating arrangements.

• *Expenditure Modules*

Investigators thought that there might be different responses according to whether the respondent was male or female. The large number of food items necessary to get an accurate measure of total expenditure per capita (120 items) made this module very difficult to complete in a timely manner.

In addition, it was difficult to ask respondents about sensitive expenditures that may account for a significant proportion of expenditures such as cigarettes, alcohol, ganja, and lottery tickets.

• *Morbidity Module*

Respondents generally did not consider certain symptoms such as colds, coughs, eye infections, and minor ailments as sicknesses to be reported to the field investigators. At the other extreme, certain cases women complained about body aches, knee pain, and leg pains

Table 21 Investigator perceptions on three methods of dietary analysis: 24-hour recall, food frequency, and food charts

Category	Food Frequency	24-Hour Recall	Food Chart
1. Time for data collection	Less time consuming	Time consuming	Time consuming
2. From whom	From the person who does preparation and marketing	The person who does preparation	The person who does preparation and marketing
3. What does the method tell us?	Seasonal information	Only one day of information (hopefully representative)	Seasonal information
4. Quantity	No quantification other than frequency	Quantification	No levels, just proportions
5. Chance of missing food items	No chance, because of prompting	Some chances	Some chances
6. Confidence in quality of response	Confident about most of the items. Not confident about a few items that are eaten rarely or occasionally	Confident Not confident about individual consumption	Confident, but often quantity gets mixed up with frequency, e.g., sugar, oil dhal
7. Level of interest on the part of respondent	Medium	High at the start (getting water volumes, etc.,) but slowly diminishes	High
8. Sense of participation	Low	Partial	Complete
9. Ability to understand	Good at the household level, pregnant, lactating and preschool children	Good at household Good for individuals if they carry tiffins (lunch boxes). Less easy for plate-individual consumption.	n.a.

n.a. = Not available.

that had been on-going for at least ten years. In certain cases women were reluctant to discuss gynecological problems. Finally, note that disease and symptom terminology differed from village to village.

• *Breast-feeding Module*

In this module none of the questions were particularly difficult for the respondents to understand, and they gave confident answers. Probing was necessary on two questions in particular: (1) At what age did you start to give the child anything other than breast milk? and (2) At what age did you start to give adult foods?

It was easy for the mother to list the names of weaning foods given to the child during the weaning period.

• *Questions about Perceptions Related to Food Security*

This module was included to give a more qualitative feel to the survey, and to induce more answers on own-perceptions of hunger and food security. Some of the questions were straightforward for respondents to answer: number of meals adult has per day, number of meals preschool child has per day, etc.

Some questions proved difficult to administer. Table 22 highlights the problem questions.

8. LESSONS LEARNED FROM THIS STUDY

This study presented two distinct methods for developing alternative indicators of food insecurity. In this section, we discuss our experience with these methods and the implications for use of each method by various organizations. Issues of process, program objectives, and available resources are discussed in the context of choosing a methodology for developing alternative indicators.

1. Qualitative Methods Are a Viable Tool at the Community Level.

Our work with qualitative methods suggest that they are a promising tool for small-scale organizations that do not have the human or financial capacity to engage in large-scale indicator development exercises. Indicators suggested through qualitative techniques, however, are not generalizable beyond the communities in which they are developed. Our qualitative experience suggests that many indicators represent coping strategies that are very location-specific; as such

Table 22 Problem questions on the food security perceptions module

Question	Problem
1. If you had an extra Rs 100, what would you buy more of?	Respondents do not understand where the Rs 100 appears from.
2. Which three foods would your family like to eat more of?	Respondents interrupt to say that they have no preferences, no money, and they eat whatever they have to eat.
3. Does your family keep poor health due to a lack of healthy foods?	Was easier for respondents to understand if we ask the same question, but in a positive sense, i.e., do you think "healthy" foods are important in maintaining good health?
4. How many days supply of basic food do you have?	A large number of days stock is misleading if the basic food is consumed with less frequency than the most basic staple; e.g., a 50-day wheat store might lead to the incorrect conclusion that the family is food insecure when they simply do not eat wheat very often.

an in-depth understanding of the local culture is needed to identify and interpret any given indicator.

The location-specificity of these indicators is not likely to be a problem for small-scale nongovernment organizations that have long-term commitments to certain communities. We believe that these organizations can (and do) use many of the same types of participatory exercises we used, as well as the more traditional ethnographic methods to develop community-specific indicators. In addition, organizations will be able to develop new participatory methods that specifically meet their needs. In general, however, more attention needs to be paid to particular combinations of indicators that are strong indicators of food insecurity. Our study did not investigate locally determined combinations, but we anticipate that they would be much more valuable than single indicators.

If indicators are identified in a qualitative fashion they can be validated over time using an NGOs "inside knowledge" of the community as well as the community's assessment of how the indicator is working to target the food insecure. Given the location-specific nature of indicators it is unlikely that "successful" indicators can be shared with other organizations without some sort of validation (quantitative or qualitative) in the new location.

The qualitative methods we used to gather information about food security conditions were simple and feasible at the community level. They did not require large amounts of data entry and data analysis time. They will require adjustments for each new situation, however. In

addition these methods require investigators with solid training in ethnographic/participatory methods. Investigators must have the capability to leave behind preconceived notions regarding food security relationships. They must learn about community perceptions about food security and observe patterns within the community. The skills necessary for this work were difficult to glean from traditional resumes; but they became more obvious once we worked with individuals in the field. Although it is desirable to have investigators with prior experience in participatory methods it is also possible to train a group of candidates in these methods and then choose the ones that show the most promise during the field training exercises.

2. Quantitative Studies Are Feasible for Programmers in the Field, But Programmers Need to Be Wary of Sample Size Issues.

Our chosen method to screen and test the alternative indicators was simple enough for a well-trained research analyst (or statistician) to carry out in-country. The most time consuming areas were (1) the determination of the most appropriate analytical method and (2) the data cleaning. If clean secondary data are available (e.g., national census or DHS survey with benchmark indicators) then it is feasible for staff analysts to undertake the same statistical tests of association that we did. If, however, it is necessary to mount a data collection and cleaning effort more personnel and funds will be needed. To the extent that indicator development exercises can be linked to the baseline data collection of a program's monitoring and evaluation system there may be opportunities to defray the costs of indicator development.

The methods we used were relatively straightforward for identifying statistical association between the candidate indicator and the benchmark. Nevertheless we found that issues of sample size were important enough to render many of our tests of association statistically powerless. Our survey, however, was not a small one; the total sample of 300 households represented over 17 percent of the total number of households in the four villages and included over 300 households. As such, we recommend the quantitative methodology for organizations that have access to large data sets (i.e.,. at least 500 observations and probably more) from the appropriate population. These data sets are more likely to offer adequate power to determine significant associations between the alternatives and the benchmarks (if they indeed exist).

This recommendation indicates that small-scale organizations may encounter analytical problems if they attempt the quantitative method we report here. It also means that large "top-down" organizations (with sufficient human resources and relatively large program mandates and data sets) are more likely to adopt this method with success.

Our recommendation is also based on the experience we had with this particular data set. In theory, sample size calculations can be carried out at the outset of any indicator study. However, it is difficult to make estimates of the variables needed for this calculation. Sample size calculations require estimates of proportion sizes as well as some indication of what

difference in proportion is meaningful. For certain analytical problems (particularly medical ones), there is a good theoretical basis for estimating the size of certain proportions and the difference between proportions that is (biologically) important. With social science indicators, these proportions are difficult to predict and difficult to attach meaning to the size of the difference in proportions. As such, accurate sample size calculations are difficult to achieve with these data.

A priori there is no reason to believe that data from other populations will behave similarly to the data represented in this study. Therefore, a sensible option for those with secondary data sets is to do the quantitative analysis and check whether there is sufficient power to determine if a nonsignificant finding is indeed a nonrelationship between the alternative and benchmark. This is the procedure we followed and we found that we did not have adequate power to test several of our indicators. This, however, does not invalidate the relationships we did find. It only tells us that we do not know whether an indicator "lost" because (1) it is truly not a good indicator or (2) it did not get a fair statistical test. The same indicator may indeed be a "winner" using a larger sample taken from the same population.

3. Does the Lack of Correspondence Between the Qualitative and Quantitative Results Mean that the Suggested Indicators Are Not Valid?

Our experimentation with quantitative and qualitative methods for indicator development indicated that there was little overlap between the results derived from each method. Does it mean that one method failed and the other one succeeded?

We believe that this particular experience should not be seen as a failure of either method. Rather problems with sample size in the quantitative survey and our inability to follow-up qualitatively on the role of combination indicators made it difficult to directly compare the results from each method.

Does it mean that the indicators suggested by the quantitative or qualitative method are not valid? No, it only means that we did not have enough statistical power (determined largely by sample size) to properly test many of the indicators suggested by the qualitative study. Some may have been validated statistically if the survey had been larger. On the other hand, some may not have been validated and this might mean that villagers' and researchers' have different perceptions about what food security really means. In either case this study in its present form cannot answer this question.

4. Qualitative and Quantitative Methods Are Complementary for Selecting Alternative Indicators.

The above recommendations are not meant to imply a lack of complementarity between the two methods. Admittedly small-scale projects may not find the quantitative method we suggested to be useful. However, with larger "top-down" projects there are many opportunities to combine the use of qualitative and quantitative techniques that will improve the reliability of the alternative indicators. Since this was a study of methods, we ran the qualitative and quantitative sections simultaneously. However, this need not be the case for a true indicator development exercise. Specifically, qualitative techniques may first be used to narrow down the list of candidate indicators. The quantitative analysis can follow, and the results may be validated using qualitative techniques in the field. Qualitative techniques may also be used in the interpretation of indicators that arise from the qualitative analysis. Our experience indicates that a keen understanding of the local context is important for the interpretation of indicators suggested by the quantitative analysis.

5. Combinations of Alternative Indicators May Be Necessary to Improve the Ability of Alternatives to Proxy for Benchmark Indicators.

As stated above, our experience indicates that combinations of indicators may be necessary to improve the performance of alternative indicators. More specifically, using indicators in combination rather than singly might tighten the relationship between groups of alternative indicators and the benchmark indicator.

This suggestion comes primarily from our ethnographic observations. In most cases we found households to be food insecure when there were a combination of disadvantaging factors. However, due to lack of time and resources we have not explored the possibility of combinations in this analysis. Nevertheless, this avenue holds the greatest potential for increasing the performance of the alternative indicators. Future research efforts should address this possibility, keeping in mind that simplicity is the key to a successful targeting program on the ground. The number of "combined" indicators should not overly burden field personnel when they are carrying out the targeting.

6. Simple Indicators with Modest Association with the Benchmark Indicator Showed Program Savings.

Simulations using the indicators identified in the quantitative study showed that indicators with significant associations with the benchmark also produced substantial savings in terms of program costs. Alternative indicators that are feasible for use in the field can therefore reduce program leakages. The examples also indicate that the program savings can be quite substantial. We note however, that the correct criteria for indicator selection include (1) an estimate of the

social costs and benefits of the intervention and (2) the relative cost of collecting the alternative and the benchmark. These net costs will vary according to each targeting situation. We underscore that program costs are not the only cost-related issues at stake. Rather, the costs of data collection and of making targeting "mistakes" must also be taken into account.

7. Qualitative Methods Are No More Participatory than Quantitative Methods if No Action Agenda Is Planned.

Finally, we must add that despite our best intentions the research-based participatory methods we used were no more empowering for the villagers than our survey methods. This is more a testament to the objective of pursuing a predetermined research agenda rather than a failure of participatory methods per se. Our experience leads us to believe that qualitative techniques are truly participatory when employed with action-orientation interventions.

9. CONCLUSIONS AND NEXT STEPS

The objective of this report has been to present two different methods to identify alternative indicators of chronic and acute food insecurity. A need for alternative indicators exists since many benchmark indicators (such as household income or dietary intake) are often too cumbersome to be of practical use in food aid targeting.

This study used data collected in four villages in the Indian Semi-Arid Tropics as way to illustrate two methods for identifying alternative indicators. Because the data were collected in only four villages it is unlikely that the results are generalizable to all of India or even the Indian Semi-Arid Tropics. With this caveat in mind the emphasis of this report is placed on our experiences with the methods. Given that the results are likely to be location and context-specific, less emphasis is placed on the indicators themselves.

The results from this study indicate that targeting with alternative indicators may be viable at the household and individual levels. Our experience also suggests that the method of indicator selection will vary according to the resources and objectives of the targeting organization. For example, targeting at the household and individual level is likely to be a component of an NGO's programming activities. Given that (1) NGOs often work intensively in a limited number of communities and that (2) financial and human resources are generally limited, the qualitative method appears to be the most viable option for these organizations. For organizations that plan to carry out a more centralized form of targeting, such as governments, large-scale NGOs, or international organizations, a combination of qualitative and quantitative methods might be more appropriate. Programmers in these organizations tend to have access to

large data bases for their area of concern as well as the human resources to coordinate a quantitative study.

There are advantages and disadvantages to each method chosen. The qualitative method requires less time for analysis, but does require staff with special talents for interpreting qualitative information. Results, however, are not generalizable and are thus very location-specific. The quantitative method requires staff with statistical skills as well as access to a large data bases that will increase the probability of sufficient power for tests of statistical association. The results from quantitative studies are more generalizable to similar populations, but can be puzzling if little is known about the program areas. As such, a combination of qualitative and quantitative methods is recommended even when the primary data collection exercise is a quantitative one.

SUGGESTED AREAS FOR FUTURE INVESTIGATION

1. Validate the quantitative methods developed here with a larger data set that provides more observations and hence more statistical power to test the alternative indicators.

   Our work was limited analytically by the lack of adequate power for our statistical tests. The same method should be attempted on a large data set to see if a more consistent set of indicators is derived across seasons and across different formulations of the same indicator.

2. Explore the power of combination indicators using the quantitative method.

   This exercise is a natural "next step" in determining the real usefulness of alternative indicators. Combinations are postulated to "tighten" the relationship between the alternatives and the benchmarks and therefore illustrate the possibilities for using combination indicators for targeting purposes.

3. Explore the relationship between indicators derived from the qualitative methods and those derived from the quantitative method (that demonstrate sufficient power).

   The lack of sample size rendered many of the statistical tests powerless to determine the strength of the relationship between an alternative and a benchmark. Conducting the same type of comparison between quantitative and qualitative results will give researchers an idea whether there is a convergence between local perceptions regarding food insecurity and perceptions of the research community.

4. Explore the relationship between alternative indicators and indicators taken from the conventional poverty literature (per capita expenditures, per capita food expenditures, and the share of total budget spent on food).

   Lack of power made it difficult for us to assess the strength of an alternative indicator relative to more conventional poverty indicators. Nevertheless, this result is consistent with the body of research that suggests that the mapping of poverty into food insecurity is complex (Bouis and Haddad 1992).

5. Explore the robustness of alternative indicators over time and across different indicator formulations. Again, lack of power made it difficult to assess these relationships. A validation of these indicators is important over time, particularly in areas characterized by seasonality.

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