IDENTIFYING THE FOOD INSECURE

THE APPLICATION OF MIXED-METHOD APPROACHES IN INDIA

Kimberly Chung, Lawrence Haddad, Jayashree Ramakrishna, and Frank Riely

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Foreword

Programs designed to assist the food insecure and undernourished are often based on the assumption that it is easy to identify the target population. But in the vast majority of cases, targeting is a complex task for any program or project manager.

The academic literature has offered some help to professionals working in the field, but not enough. Most indicators traditionally used to identify food-insecure and undernourished households and individuals are based on the time-consuming process of assessing household consumption (by measuring total expenditures, for example) or the nutritional status of individuals. But there has been little practical research for project managers who need to make fast decisions about whom to target. How can these managers quickly identify the most food-insecure households and individuals? What criteria should they use to decide who receives transfers such as food aid? When do the benefits of targeting justify the costs of collecting the information that is needed to make targeting decisions?

This study analyzes these questions by reporting on a novel combination of quantitative and qualitative approaches for identifying indicators of poverty, food insecurity, and undernutrition. These indicators are meant to be simple to collect and simple to analyze. The findings from this study show that a combination of qualitative and quantitative methods is highly desirable in choosing alternative indicators. For any given development program, however, the balance of this mix will depend on the targeting objectives and the resources available. The findings also suggest that targeting can provide substantial savings to programs, but that targeting based on a poor indicator can be more costly than no targeting at all.

Per Pinstrup-Andersen, Director General, IFPRI
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As long as the reduction of poverty, food insecurity, and undernutrition remain high on the development agenda, the targeting of initiatives will remain an important concern. The Consultative Group on International Agricultural Research (CGIAR), in particular, remains committed to targeting its activities toward poverty reduction. The research contained in this volume sheds some light on the complexity of targeting decisions. It contributes to our knowledge about improved targeting but makes clear that there is no simple formula for developing new indicators. The lessons learned from this research will be useful to a wide range of development organizations planning to target benefits and programs toward poor, food-insecure, and undernourished populations.

The work reported in this volume represents a collaborative effort by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the International Food Policy Research Institute (IFPRI), two of the research centers in the CGIAR system. We have undertaken this work jointly as part of our shared commitment to addressing questions of poverty, food insecurity, and undernutrition in the developing world. IFPRI has long analyzed targeting issues in the context of famine relief, vulnerability mapping, the location of public works programs, and the design of food subsidies and other safety nets. ICRISAT has for years studied how resource-poor households respond to new agricultural technologies, resource management challenges, and economic incentives. This work represents perhaps the most conscious attempt yet to generate research results and methods that will have a direct operational impact on the design and implementation of food and nutrition interventions.

Acknowledgments

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Summary

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

The study uses data collected in four villages in the semi-arid tropics of south-central India to illustrate a qualitative and a quantitative method for identifying alternative indicators. The qualitative methodology used ethnographic case studies of at-risk households, participatory mapping of vulnerable households within a community, food charts, and seasonality charts. The quantitative methodology used both economic and nutrition surveys to collect data from 325 households over three rounds in 1992/93.

For the qualitative work, both the villagers' perceptions of food insecurity and the ethnographers' observations were used to generate a list of indicators. Results from the various qualitative methods were compared to validate the indicators suggested. For the quantitative work, statistical methods were employed to test the strength of association between each indicator and six benchmark measurements of food security. The benchmark measurements were derived from three sources: dietary recall and anthropometric and blood data. The dietary data were used to generate benchmarks for chronic and acute household 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.

A core set of alternative indicators was tested against each of these benchmarks. The majority of the alternative indicators came from a review of the food security literature as well the qualitative work conducted as part of this study. Other indicators represent information typically available in secondary data sets collected by governments and research institutions.

For each benchmark, the quantitative tests involved two steps. First, the indicators were screened for their statistical association with the appropriate benchmark. Then a hypothesis-testing framework was used 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 then tested in targeting simulations to explore what savings could be achieved by using indicators to target food aid distributions. The simulations assumed a certain set of program characteristics. Given that program parameters will vary, these simulations illustrate the potential benefits of targeting. The results of the simulations indicate that modest but significant associations between a targeting indicator and the benchmark can provide savings in program costs. In some cases, the program savings can be substantial. However, program costs are not the only cost-related issue; data collection costs and the social and financial costs of making targeting mistakes must also be considered. A full accounting of these costs can render an alternative indicator less efficient than a benchmark indicator.

If a benchmark indicator is either too expensive or infeasible to use, which method—qualitative or quantitative—is more appropriate for choosing an alternative indicator? This study 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, nongovernmental organizations (NGOs) are likely to target their programming activities at the household and individual levels. Given that NGOs (1) often work intensively in a limited number of communities and (2) generally have limited financial and human resources, the qualitative method appears to be the most viable option for these organizations.

Organizations such as governments, large-scale NGOs, or international organizations that plan to carry

out more centralized forms of targeting may find a combination of qualitative and quantitative methods more appropriate. The quantitative methods, however, require large sample sizes for statistical testing as well as personnel and equipment to collect and analyze these data. Only institutions with the requisite financial, human, and computing resources can effectively use these methods.

Clearly, each method has advantages and disadvantages. The qualitative methods require less time for analysis but depend on staff with special talents for collecting and interpreting qualitative information. In addition, qualitative results remain specific to the location of the study and cannot be generalized to other locations without more study. By contrast, the quantitative methods require 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 can be more readily applied to similar populations, but may be difficult to interpret if little is known about the context in which the studies were conducted. Qualitative information is therefore useful for identifying and evaluating indicators even when a quantitative approach is taken.

Finally, it is important to underscore the difference between using a qualitative method and a participatory one. Participatory methods were used for this study because they were believed to be more respectful of and empowering to the communities studied. Despite our best intentions, however, the participatory methods (as applied to our research objectives) were no more empowering for the villagers than the chosen survey methods. This is the result of applying participatory methods to a predetermined research agenda, for which local input has little effect on the course of research. Under these conditions, no research method can be highly empowering for the respondents, and this experience should not be interpreted as a failure of participatory methods. Rather, this experience underscores the fact that qualitative methods are truly participatory only when used in connection with action-oriented interventions.

1

Introduction

The Need for Alternative Indicators of Food Security for Targeting

One of the many objectives of food-related information systems is to help target scarce resources toward the food insecure. Although targeting is not a new tool, its use has become more relevant in today's era of ever-shrinking aid budgets. To be successful, however, a targeting system must use indicators that are valid and reliable for identifying at-risk groups and still straightforward and inexpensive to use. In spite of this obvious need for good indicators, 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 require data that 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. Previous work by Haddad, Sullivan, and Kennedy (1992) suggested that several simple-to-collect indicators (such as number of unique foods consumed, dependency ratio, household size, rooms per capita), coded with only two or three different values, could be useful to identify food-insecure households and preschoolers. Although the message of this work was welcomed by the food aid community, other researchers identified significant weaknesses in the method of analysis (Khan and Riely 1995, Cogill 1994). As a result, the usefulness of alternative indicators remained uncertain.

The research presented here, however, builds on the ideas presented in Haddad, Sullivan, and Kennedy (1992) but uses a more robust analytical strategy to evaluate the concept of the alternative indicator. A strategy of mixed methodologies is followed. Quantitative methods are used to test the performance of indicators derived from theory, while qualitative methods that rely on indigenous knowledge are used to contextualize the identification process. The two-pronged approach is an improvement over the method of analysis used by Haddad, Sullivan, and Kennedy (1992). The quantitative methods used in this study overcome the statistical weaknesses in the previous study. In addition, qualitative methods are used to detect location-specific indicators that could not have been suggested by theory alone.

The Need for Alternative Indicators in India

Fortunately, famines in India are a "nightmare of the past" (Gopalan 1992). Food production has kept up with population increases, government buffer stocks of grain have stabilized food grain prices, democracy and a free press give the rural poor a voice, relatively efficient interregional grain markets now exist, informal consumption credit is available, and a set of explicit famine-relief policies such as rural public works programs is now in place (Drèze 1988; Bidinger et al. 1990).

Given the successful prevention of famine in India, is improved targeting of food security and nutrition programs needed? Two examples illustrate 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 United Nations Development Programme (UNDP), 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 deplete scarce resources that are subject to other demands as well. For example, India's Title II food aid program has ranked as the world's largest nonemergency 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 widespread belief that current levels of food security in India could be achieved with less strain on public

expenditures if policies better targeted 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. The Integrated Child Development Service (ICDS) asks health workers 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 themselves of this work scheme. However, undercoverage is a concern for many of these programs; that is, not enough needy households or individuals receive benefits (Kennedy and Slack 1993). The level of wasted program resources (so-called program leakage) can be high in some areas, with benefits accruing to those who would not otherwise be considered needy (NIPCCD 1989). Interviews in the study villages indicated a frustration among *aganwadi* workers in their inability to target resources better (Vasantha 1993).[1]

Resources mobilized to combat food insecurity—whether from the Government of India or from donor organizations—will be more effective if 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 to target and implement 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 requests of policymakers and practitioners, 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 —including both generic indicators, derived from a general conceptual framework of food security and not unique to a particular setting, and location-specific indicators, derived from qualitative field methods in the study area;
2. identify appropriate targeting indicators by testing the statistical association of each generic indicator with more direct, benchmark measures of food security; and
3. assess the relative performance of each of the targeting indicators for improving the efficiency of food security and nutrition-related programs, that is, reducing program costs and maximizing the social benefit associated with programs.

Outline of This Study

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 and qualitative 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. A quantitative approach is also presented. For this method, the alternative indicators are compared with a set of benchmark indicators that are presumed to represent the true food security situation. The benchmark indicators are based on measures of caloric adequacy, anthropometry, and serum markers.

The performance of the quantitative alternative indicators is judged both by the strength of their association with the benchmark indicators and by 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.

[1]An *aganwadi* worker is an individual from the local community who is responsible for recruiting ICDS participants, organizing health and nutrition education classes, distributing supplementary foods, and maintaining records.

2

The Literature on Food Security Indicators

Food and Nutrition Monitoring in India

A large number of nutritional assessment studies were undertaken in India over the period 1918–72.[2] 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 the dietary intakes and nutritional status of representative segments of the Indian population, using standardized procedures and techniques, and to undertake periodic evaluation of ongoing national nutrition programs.

An 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 with simple and sensitive indicators that would be useful for 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 among 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.

NIN has identified the need for indicators with such characteristics 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.

Conceptual Framework for Understanding Food Security

This study uses 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 agrophysical, 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 of 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). A 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

[2]Appendix 1 of Chung et al. (1996) provides a more complete review of nutrition monitoring systems in India.

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]); (2) the social cost of remaining food insecure, that is the per capita social cost of the food insecurity problem 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 (3) targeting costs, that is, the costs associated with identifying targeting indicators and collecting and analyzing this information from individuals who are candidate participants in the program. Total cost is represented as follows:

$$C_i = r(TP_i + FP_i) + sFN_i + D_i, \qquad (3)$$

where

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

With some types of interventions, additional costs might be associated with treating false positives. Some health interventions, for example, produce deleterious side effects in individuals who 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, for example, to vitamin A megadose supplementation), 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); 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.

In contrast, calculating the program costs of delivering a set of goods and services to program beneficiaries is relatively straightforward, as is determining the targeting costs. 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 and the ability to share costs with other program functions.

In a research setting, for example, data collection costs can be 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 have to be specially purchased for the research effort as well. In addition, where population densities are low or survey locations are spread out across distant sites, the logistical costs of information gathering may be quite high.

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 are likely to be minimal. In this setting, the cost of gathering information is primarily the opportunity cost of the time of existing field staff. This cost may vary considerably, not only with the complexity of the data collection task, but also according to whether information is gathered at a central location or through visits to individual households. An important concern in any program-based data collection effort is the possible erosion in the quality of the program's goods and services, 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 program operations, some type of qualitative and quantitative fieldwork is 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 requires an ongoing data collection effort that may be quite distinct from the first. To the extent that the first process (assessment of targeting indicators) can be linked to the second (baseline data collection), there may be opportunities to significantly contain information system costs.

This study focuses on methods 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 set-

ting—particularly ongoing screening costs—this study carries out various targeting simulations to illustrate the method for determining the worth of an alternative indicator. The simulations 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 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

The four villages chosen for the study are located in three districts in two states of India. Aurepalle and Dokur are located in Mahbubnagar District in Andhra Pradesh, Kanzara is in Akola District, Maharashtra, and Shirapur is in Sholapur District, Maharashtra (see Figure 2). All four villages were part of the longitudinal Village Level Studies (VLS) conducted by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) during 1975–84 (Old VLS) and the 1989/90 crop year (New VLS). These data have been the subject of many studies and are well documented in Walker and Ryan 1990.

The VLS covered six villages for a two-year period (1975–77) and three villages for a 10-year period (1975–85). Visits to the villages in March 1992 indicated that a six-village study would be logistically difficult.[10] Kalman and Kinkheda villages were dropped from the sample because agricultural conditions there were found to be similar to those in other villages. Specifically, rainfall patterns (and hence crop performance) are quite similar in Kanzara and Kinkheda, yet they vary considerably from those found in the dry Sholapur District, where Kalman and Shirapur are located. The Mahbubnagar villages, Aurepalle and Dokur, showed significant variability in cropping patterns and irrigation practices, so both villages were retained in the sample.

All four village economies are based on rainfed agriculture, but rainfall is low and particularly erratic in Mahbubnagar 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 of and demand for two rural products, toddy (local liquor) and sheep, have diversified the village economy away from crop production. The effect has been to make many 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.

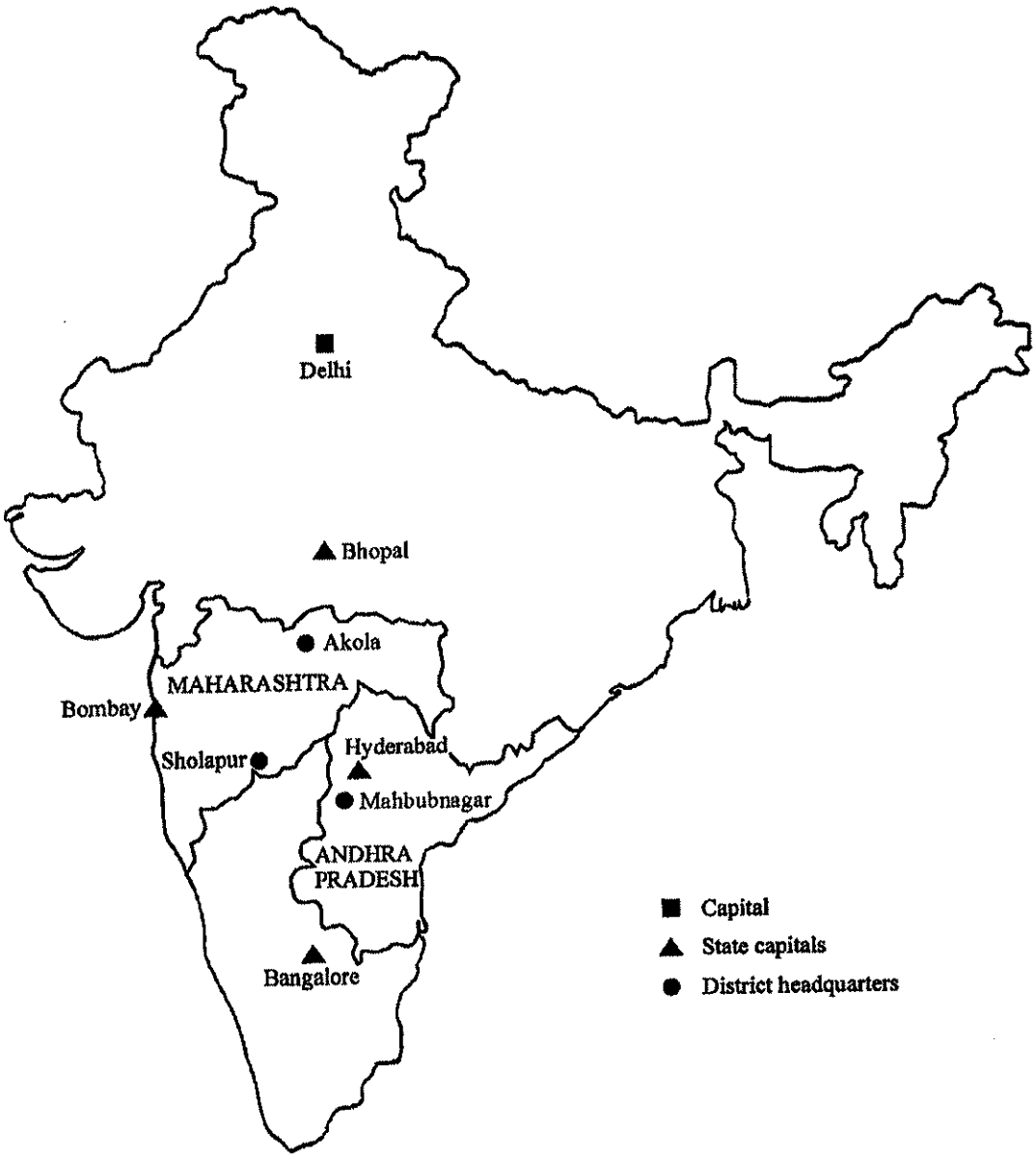
Dokur, like Aurepalle, is situated in Mahbubnagar District but is significantly different in two respects. First, the land is heavily irrigated, primarily from a large local tank. The effect of irrigation is clear: opportunities for employment are greater in the post-rainy and summer seasons. Second, 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 very much depends on local crop production. A government Employment Guarantee Scheme (EGS) provides work for villagers, but the demand for labor is inconsistent and insufficient to employ all that need work. Shirapur is located relatively close to Sholapur city, the district capital, but there is no tradition of 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 and summer seasons because of canal irrigation. Kanzara, however, is situated at the end of the canal, so irrigation is not assured. Neighboring villages do have more as-

[10]We were constrained by our inability to find investigators who were fluent in Marathi and could carry out the nutrition surveys. Limiting 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 area



Source: Adapted from Walker and Ryan 1990.

sured access to canal irrigation, so the demand for labor is usually quite stable. The year in which this 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 post-rainy season. In addition, untimely rains during the late monsoon season made the sorghum crop moldy and thus caused producer prices to plummet.

The majority of households in the study are caste Hindus. In each village there is a wide variety of castes, but usually one or two dominant caste groups can be identified. In this study, 12 to 15 different castes were represented in the sample taken from each village. The many castes have been categorized by the government into four groups: forward castes, backward castes, scheduled castes, and scheduled tribes. Table 4 shows the caste composition of the sample taken from each village.

The four villages are described in more detail in Chung et al. 1996, Appendix 3.

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 kilometers south	125 kilometers south	365 kilometers west	528 kilometers northwest
Rainfall (general)[a]	Unassured; 630 millimeters	Unassured; 630 millimeters	Unassured; 630 millimeters	Assured; 890 millimeters
Total rainfall in 1992[b,c]	428 millimeters (38.72)	578 millimeters (57.11)	319.4 millimeters (36.17)	450.6 millimeters (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, and groundnut	*Kharif* sorghum, pearl millet, caster, paddy, pigeon pea, and 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
Dominant caste groups[a]	Reddis	Reddis	Marathas, dhangars	Mali, marathas
Percent literate adults	32%	29%	49%	66%
Average per capita landholding (hectares)	1.46	0.77	1.95	1.94
Mean household energy intake (calories per adult equivalent per day)	2,265	2,298	1,957	2,044
Mean iron intake (milligrams per adult equivalent per day)	9.5	7.8	17.4	17.4
Mean carotene intake (micrograms per adult equivalent per day)	408	528	1,248	864
Average per capita land cultivated (hectares)	1.18	0.31	1.58	1.90
Mean per capita total expenditure (Rs per week)	58	45	67	41
Average price of sorghum, 3 seasons (Rs per kilogram)	3.08	3.20	5.10	2.97
Average price of market rice, 3 seasons (Rs per kilogram)	5.37	5.10	5.84	6.72
Average 1992/93 male daily wage (Rs per day)	18	20	25	22
Average 1992/93 female daily wage (Rs per day)	10	11	12	14

[a]Walker and Ryan 1990, 4, 13.
[b]Unpublished ICRISAT data.
[c]Figures in parentheses are monthly standard deviations.

Table 4—Caste groups represented in survey

Caste	Number of households	Type of caste	Caste	Number of households	Type of caste
Dokur			Aurepalle		
Reddy	17	Forward caste	Reddy	9	Forward caste
Vishnavalu	1	Forward caste	Brahmin	1	Forward caste
Bhatrajulu	2	Backward caste	Velamma	1	Forward caste
Jogi	1	Backward caste	Bogamma	1	Backward caste
Golla	7	Backward caste	Katika	1	Backward caste
Mangali	1	Backward caste	Gowda	26	Backward caste
Telega	27	Backward caste	Wadla	2	Backward caste
Wadla	1	Backward caste	Chakali	3	Backward caste
Medari	2	Backward caste	Kurma	11	Backward caste
Idiga/Gowda	2	Backward caste	Telega	2	Backward caste
Mala	2	Scheduled caste	Mala	6	Scheduled caste
Madiga	9	Scheduled caste	Madiga	14	Scheduled caste
Musti	4	Scheduled caste	Baindla	2	Scheduled caste
Boya	8	Scheduled tribe	Muslim	1	Not applicable
Shirapur			Kanzara		
Maratha	46	Forward caste	Maratha (destimukh)	7	Forward caste
Rajput	1	Forward caste	Maratha (patel)	2	Forward caste
Koshti	3	Forward caste	Gosavi	4	Backward caste
Wani	2	Forward caste	Jiremali	37	Backward caste
Mali	1	Forward caste	Suvarnakar/Sonas	2	Backward caste
Dhangar	16	Forward caste	Kumbhar	2	Backward caste
Mahar	4	Forward caste	Barber	2	Backward caste
Gonahali	1	Backward caste	Dhobi	3	Backward caste
Koli	1	Backward caste	Kaikad	1	Scheduled tribe
Kumbhar	1	Backward caste	Nar Bondha	10	Scheduled caste
Sonar	1	Backward caste	Matarg	4	Scheduled caste
Mang	1	Scheduled caste	Muslim	6	Not applicable
Huler	1	Scheduled caste			
Muslim	2	Not applicable			

Data Collection Methods

The different data collection methods were used to (1) examine qualitative and quantitative methodologies for identifying and testing alternative indicators and (2) determine 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

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 5 shows the modules for which data were collected in each of the study villages. Since one objective of the survey was to identify the methods that were most successful in the indicator identification exercise, several modules offer overlapping information.

The survey modules were 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.

Many nutrition and health questions focused on women 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

Table 5—Survey information collected

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

role within the household and may therefore have an impact on food and nutrition security beyond that associated with reproduction.

Qualitative Data Collection Methods

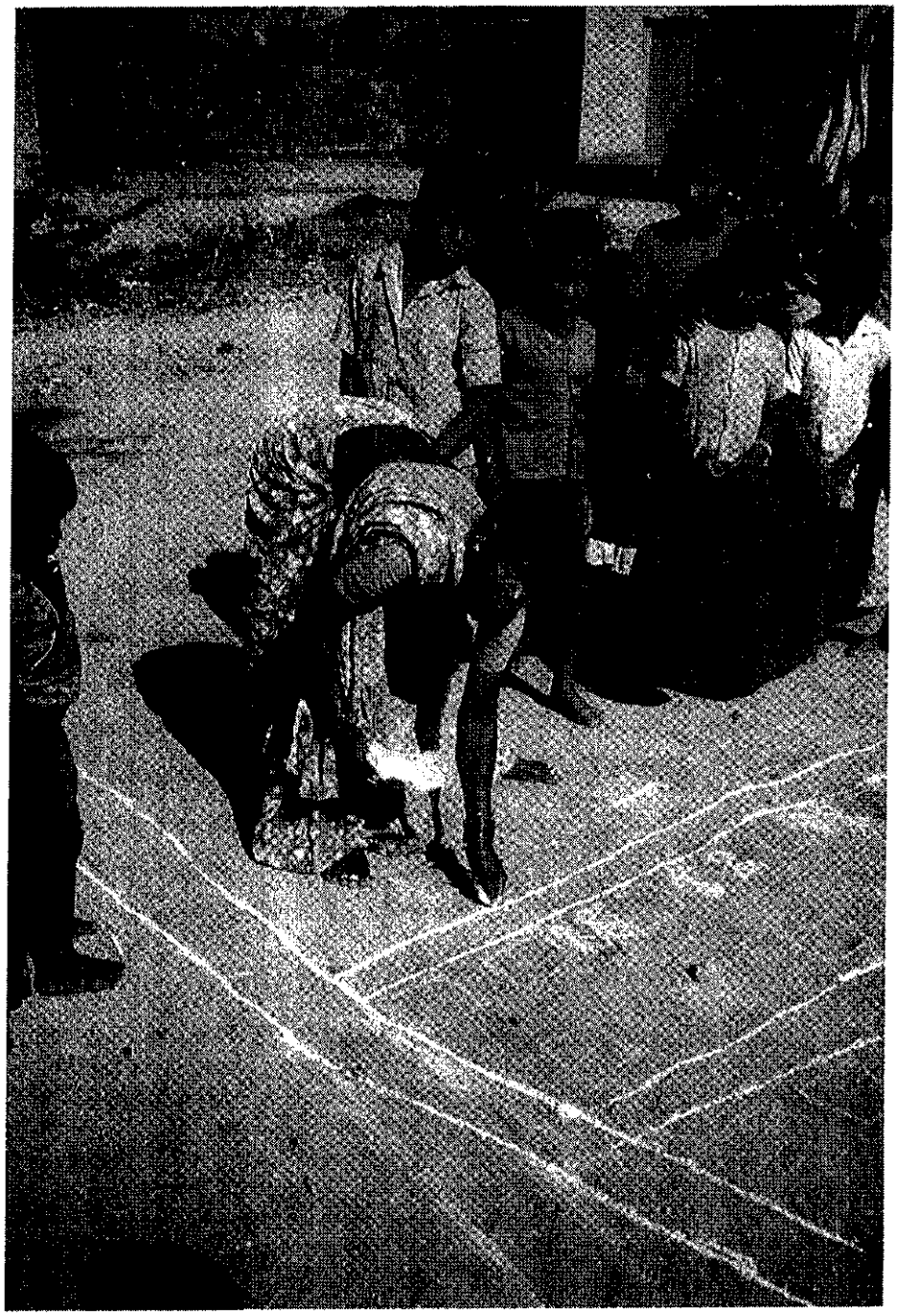
In addition to the survey data, qualitative data were also collected in two villages, specifically, participatory rural appraisal (PRA) modules, season-specific village-level ethnographic reports, and 13 case studies of selected families. This information was used to develop unique location-specific indicators of food and nutrition insecurity and to provide qualitative support for the information produced by the survey.

Participatory Rural Appraisal. 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 appropriate to the setting. Another way is to use data collection methods that encourage researchers to listen to, and learn from, respondents (Chambers 1991). PRA does this while adhering to the principles of optimal ignorance (not trying to find out more than is needed) and appropriate imprecision (not measuring something more accurately than is necessary for practical purposes). Because of this simplified approach, data collection costs are a fraction of those associated with traditional surveys.

As a research approach, PRA has evolved from rapid rural appraisal (RRA). Unlike RRA, however, it places a greater emphasis on empowering local people through data collection and analysis and relies more heavily on visual (as opposed to verbal) methods of data gathering. The application of PRA methods to nutrition and health is relatively recent and has been limited mostly to project development and evaluation.

For this study, pictorial PRA methods were used to obtain local perceptions of the characteristics of food-insecure individuals and households. Three methods were chosen: village mapping, food charts, and seasonality charts (see Chung et al. 1996, Appendix 5 for the guidelines for PRA methods for this study). Village mapping identifies households 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, they draw the map on the ground using *rangoli* (colored powder) provided by the investigators. The same group of villagers is then asked to identify

Figure 3—Village map drawing in Aurepalle, round 3

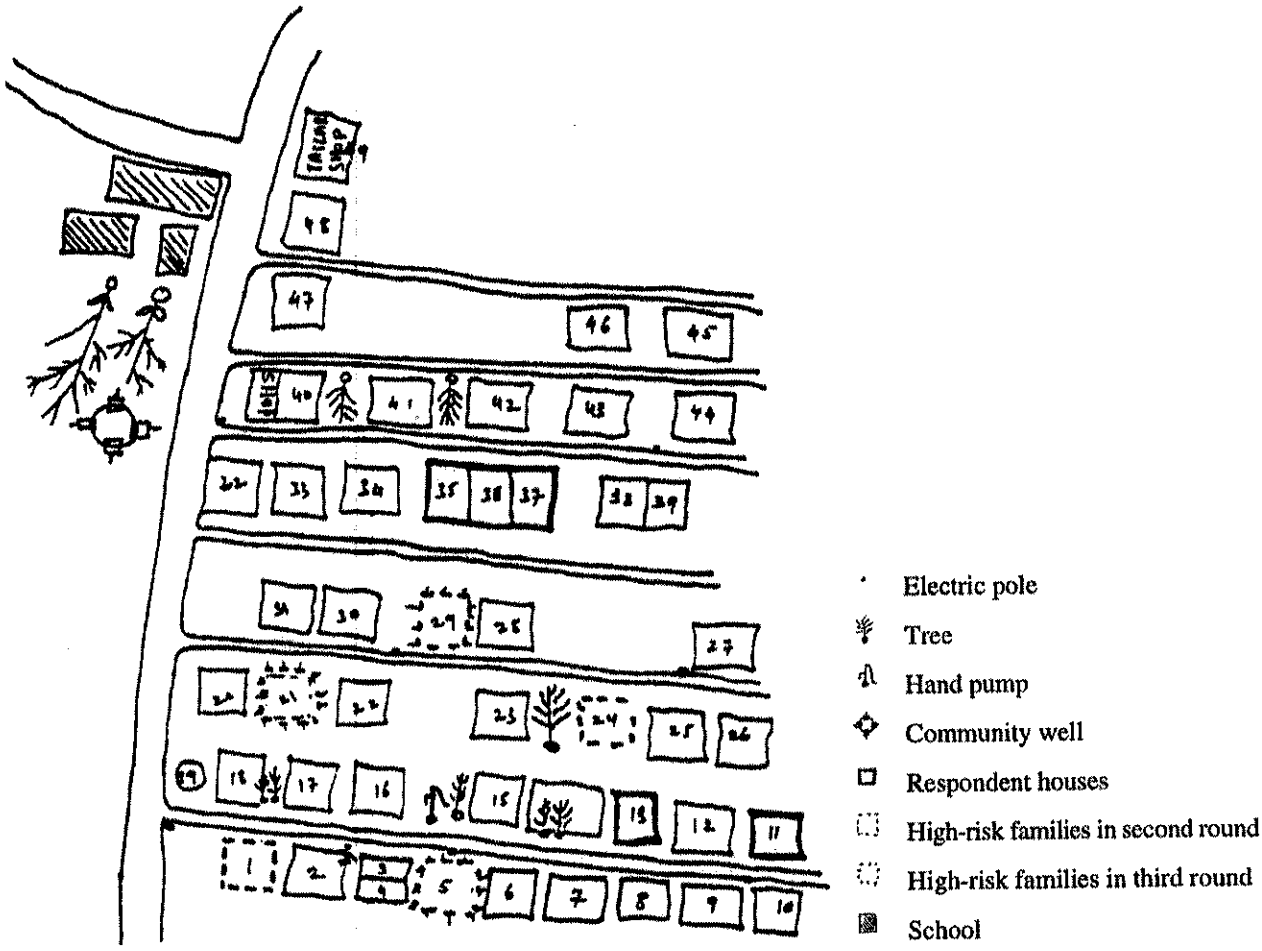


households at very high risk of food insecurity by local standards. The villagers then provide reasons for why these households were chosen. These reasons serve as emic, or locally defined, indicators of food insecurity.

The identification exercise is conducted separately with men and women to determine gender-differentiated perceptions of risk. Figure 3 shows a map being drawn in Aurepalle during the last round of data collection. Figure 4 shows an example of a completed map.

The construction of food charts was undertaken at the household level. The informant in each household is the person in charge of cooking. The informant is

Figure 4—Example of a completed village map



asked to list the foods eaten 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 uses a small bag with a sample of the food to represent each food item. She places it on a sheet of paper in front of the informant. The informant is asked to place 10 beans in a column above the food item most consumed and 1 bean on top of the food item least consumed. Consumption of other foods is rated using 1–10 beans, using the two foods just identified as endpoints. Next, the informant is asked to place colored beans below each food item to signify the frequency of consumption. 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 is a seasonality chart. This method is used with small groups (differentiated by gender and caste) to determine the changes in rainfall, harvests of two main staples, food consumption, male and female labor demand, childhood illness, and women's illness over the previous 12 months. The group is asked to place 10 beans of one color in a column above the month in which a particular characteristic (for example, rainfall) was highest. The group is then asked to place 1 bean above the month in which the same characteristic was least evident. The remaining months are rated or ranked using these two endpoints as reference points. The result is a histogram-like picture with 1–10 beans above each month, illustrating the seasonal trends over time. This exercise is repeated with a higher-caste group to capture intravillage heterogeneity in perceptions. Figure 7 shows a group of low-caste men charting the availability of work in Aurepalle. The

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

Figure 6—A completed food chart

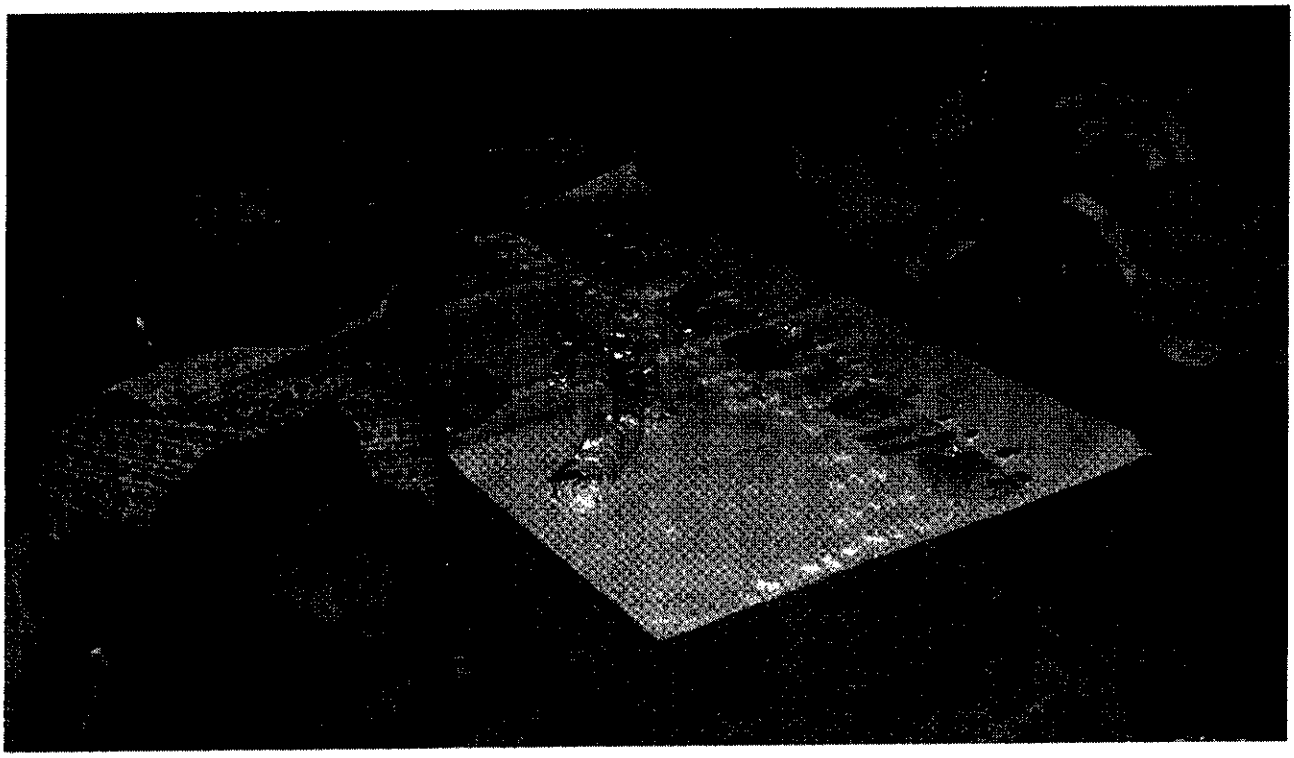


Figure 7—Low-caste men charting availability of work in Aurepalle

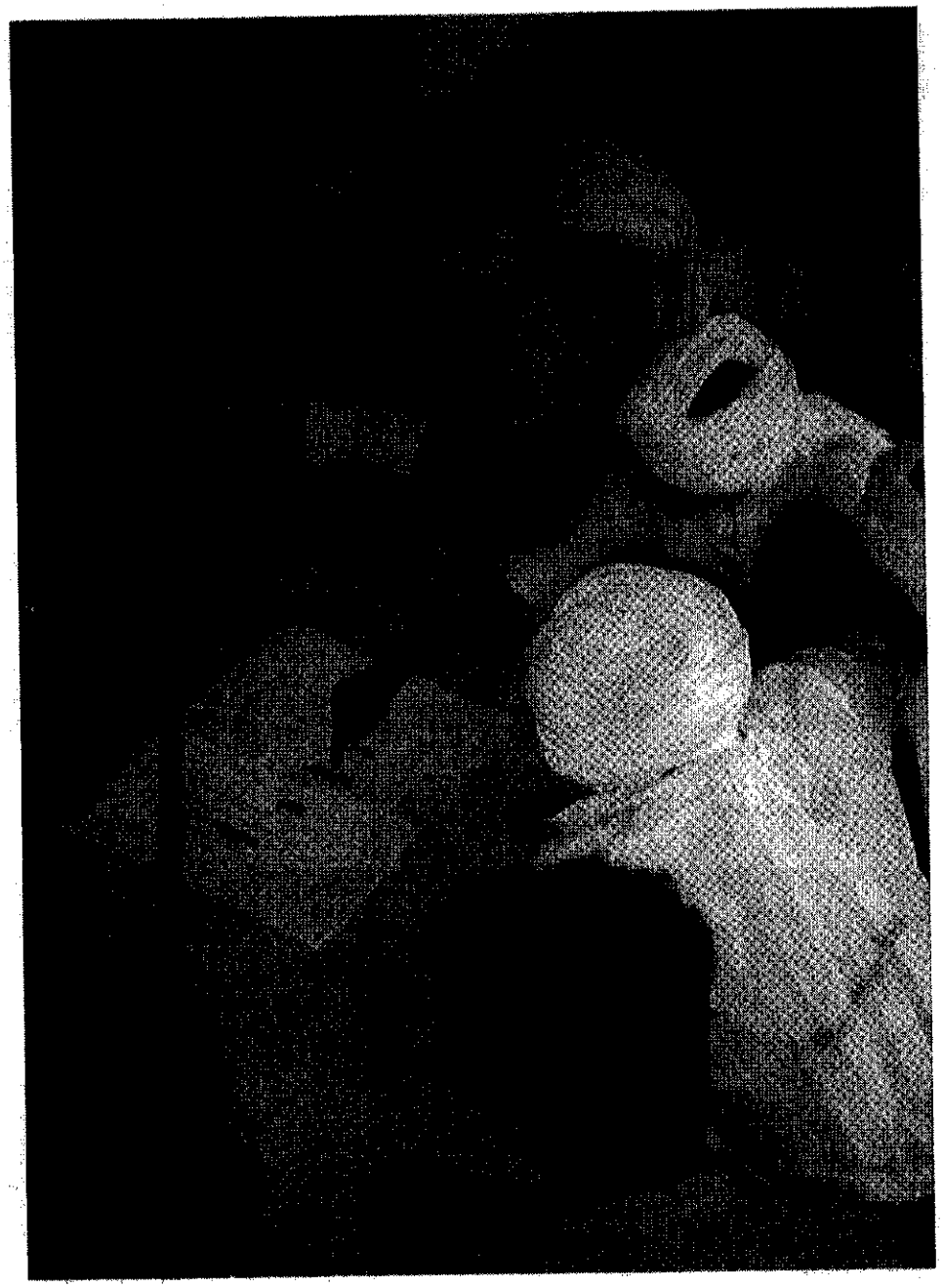
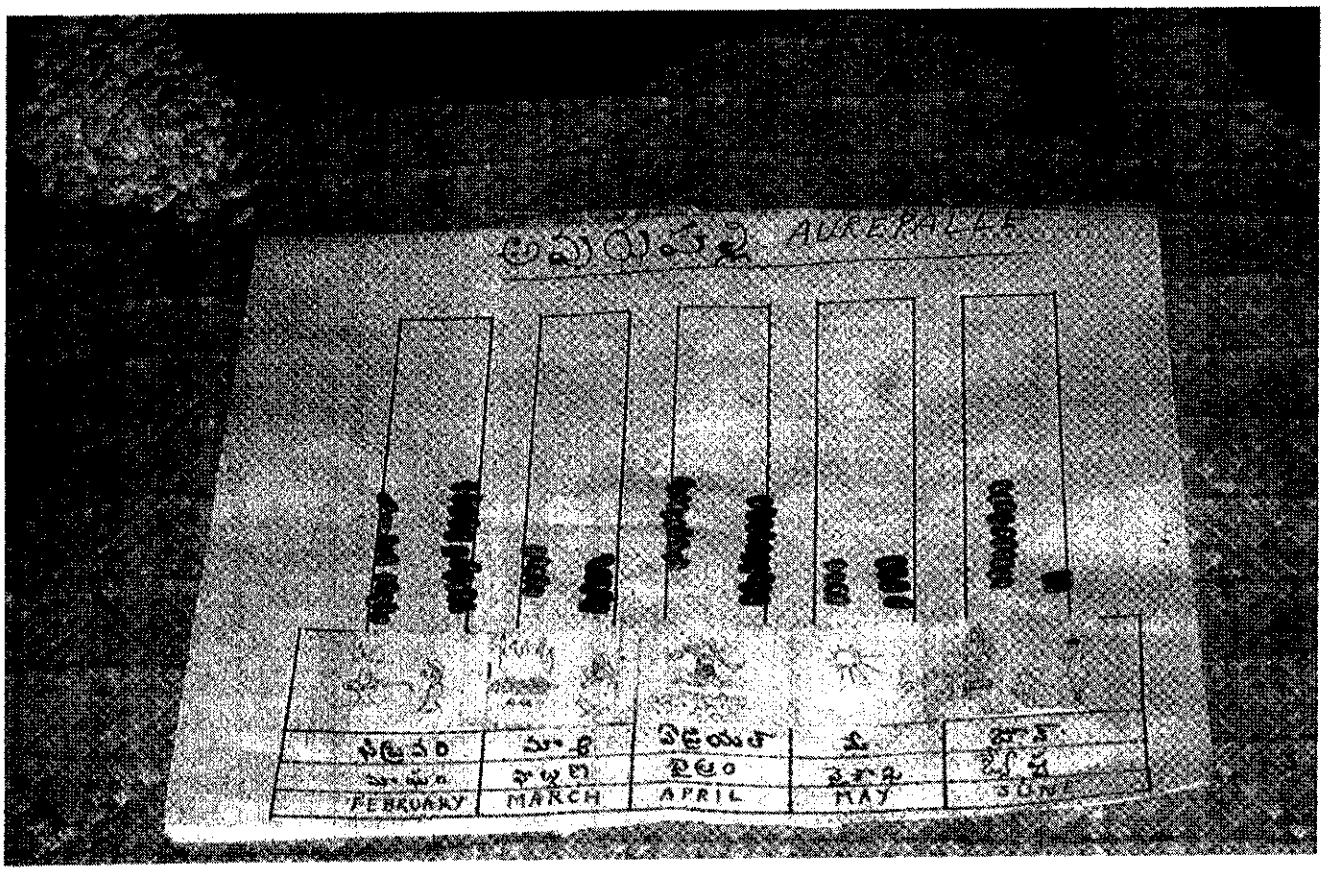


figure shows that the exercise is characterized by lively discussion. Figure 8 shows a completed seasonality chart. Pictures of local festivals and agricultural events are used to depict the months of the year. These pictorial representations help to increase participation by illiterate villagers.

Ethnographic Case Studies. In a further attempt to learn how villagers describe the concepts of hunger and food insecurity, an ethnographer was placed in Aurepalle and Shirapur for the duration of each survey round. The ethnographer used unstructured interviews, key informant interviews, group interviews, and participant observation to conduct both household case studies and 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 can then be compared with

Figure 8—A completed seasonality chart



the etic indicators produced by the survey (defined by the researchers or "outsiders").

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

1. What are local perceptions of health and food security? Does this vary by sex and age? What community, household, and individual resources are required to obtain health and food security?
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? How does this diet change in times of plenty or scarcity, 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 and nutrition security?
5. What is the decisionmaking process within the household with regard to achieving food and nutrition security or responding to problems in its attainment? Who makes specific decisions, and how are resources allocated and reallocated? What is the bargaining power of different family members?

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 (1986). Vitamin A samples were analyzed using a vari-

Table 6—Timing of the three survey rounds in the four study villages

	1992					1993						
Village	**August**	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**
Aurepalle												
Round			1					2				3
Typical food availability			Surplus					Medium				Low
Season			*Kharif*					*Rabi*				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*					Early *kharif*
Kanzara												
Round		1				2					3	
Typical food availability		Medium				Surplus					Medium-low	
Season		*Rabi*				*Rabi*					Late summer/ early *kharif*	

ation of the microfluorometric technique reported in Sivakumar 1977.

Choice of Households Surveyed

The size and composition of the sample was selected to maximize (1) the use of the Old VLS time series for future analyses of structural factors affecting current food and nutrition security and (2) intravillage 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 nutrition baseline from 1976–78 for individuals in the 240 Old VLS households. The children in this latter 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 can be performed, it was necessary to (1) resurvey as many of the 120 Old VLS households as possible and (2) survey the households of individuals who have separated from the original Old VLS households (spin-off families). An investigation of the spin-off families increased the survey burden in each of the Old VLS villages, so the number of villages investigated in this study had to be reduced from six to four.

To maximize intravillage variation, the sample was expanded beyond the Old VLS sample and its spinoffs. Specifically, the New VLS households were included and a few non-VLS families were added to bring the sample to roughly 80 households in each village, totaling 325 households in the four villages. The sample represents 17 percent of the total number of households in the four villages.

Unfortunately, the longitudinal analysis, beyond the three-round 1992/93 analysis, proved infeasible given the resources available to the project. The primary difficulty lay in linking individual records across the two data sets. Past documentation was available on the Old VLS household-level data, but the individual-level data were not as clean. Therefore, further cleaning would have been necessary before the two individual-level data sets could have been linked. Nonetheless, the data collected for this study will permit future analysis.

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). Surveys were therefore conducted in 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.

Table 6 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 are often insignificant until later in the *kharif* season. The late *kharif* (round 1) season tends to be the busiest season in all the villages except Shirapur because it is the main cropping season. In Shirapur, by contrast, farmers plant at the end of the rainy season, so the post-rainy (round 2, *rabi*) season is the busiest. The main staple crop harvest usually takes place in late October in Kanzara, November in Aurepalle, December and January in Dokur, and February in Shirapur. In all four villages, smaller staple crop harvests occur at other times of the year. In general, however, the late summer or early *kharif* season is a period of relative scarcity because the smallest staple crop harvest occurs then. Furthermore, in 1993, the monsoon began late, and as a result, little to no agricultural activity occurred during the late summer, early *kharif* (round 3) 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 to (1) identify indicators that show which households remain consistently food insecure, (2) observe which indicators are independent of changes in season, and (3) find alternative indicators that predict which households will move in and out of food security, experiencing periods of acute food insecurity. Only longitudinal data provide this opportunity.

5

Results of the Qualitative Methods

The qualitative methods described in Chapter 4 were applied in two villages, Aurepalle and Shirapur. Over the course of approximately one year, researchers used the participatory and case study methods to elicit information on local perceptions of food insecurity. Triangulation among the various qualitative methods produced the following set of indicators:[11]

- Owning poor-quality land or no land
- Holding distress sales of large livestock or small livestock
- Holding distress sales of other productive assets
- Holding distress sales of other valued assets, such as jewelry
- Taking out a high number of small loans, especially from informal sources (neighbors, relatives, and shopkeepers)
- Choosing drought-tolerant crops when more profitable but risky options exist
- Relying heavily on wage work
- Accepting attached laborer positions
- Women who work for wages and have young children
- Migrating in search of work
- Having few income earners in a large family
- Purchasing staple grains more than once a week
- Suffering from physical disabilities or chronic illness
- 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)
- Providing dowries
- Buying gifts and fulfilling obligations to relatives
- Celebrating religious holidays

The evidence for each indicator is discussed here. To protect the privacy of the individuals mentioned, all names have been changed.

Productive Assets: Land

In Aurepalle and Shirapur, 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 because of landlessness or the lack of good-quality land. The in-depth case studies supported this finding. Specifically, many case studies showed that landless families are uncertain, day-by-day, whether they will find work. In Aurepalle, Chinnama's family of seven was landless, and she could not consider sitting home for a single day. She said, "If I lose wages for one day, then we must struggle for two days to eat." Similarly, in Shirapur, Krushnabai, a landless widow, depended heavily on her partially disabled son's wages—"if and when he gets them"—to buy groceries. Owning land, she claimed, would make it easier for them to obtain loans. In addition, they could lease out the land and collect rent. This would take the pressure off days when no wages were 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 a substantial five acres of dryland. However, the lack of irrigation meant that farm production hinged on abundant and timely rainfall. In Shirapur, roughly three years in five are poor rainfall years, hence the risk of poor crop

[11]All of the indicators were identified by the villagers except the following: migrating in search of work, providing dowries, buying gifts and fulfilling obligations to relatives, and celebrating religious holidays. These were derived from the authors' observations.

production is great. The year of this study was not unusual: Pandhari Gofne received only 50 kilograms of sorghum from his land, just enough to feed his extended family for a month.

In contrast, access to irrigation meant that inferior land could be fairly productive. 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 interviews revealed that livestock ownership or sales could also be a good indicator. In both villages, the ethnographers observed that poor households rarely owned large livestock. In Aurepalle and Shirapur, 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 the animals or any cash to rent them. The most resource-poor households lack relations with those who own bullocks. A. Sayalu of Aurepalle, for example, owned 2.5 acres of low-quality land (*banjar dubba*). Because he did not have access to bullocks, he had to either borrow money from the village moneylender (*savakr*) to rent them or let his land sit idle. The year of this study, Sayalu decided to let his brother graze animals on the land rather than farm it. Larger farmers, in contrast, owned a number of large livestock such as cows, bullocks, and buffaloes and 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 a burden to families living on the edge. Usually, if a poor family owned any large animals, it owned just one or two. During bad agricultural years (such as the year of this 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 sell its bullocks—a seemingly profitable asset. Deepak Gofne explained that their bad harvest left them unable to afford fodder for the bullocks.

The experiences of the families who owned buffaloes and Jersey cows were 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 cut in half the amount of fodder fed to his remaining cow. Milk production, he predicted, would fall, probably making it 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 sell them. When they do, it is because they have no other choice. Shaik Abdul Ahemad, an attached laborer[12] 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. Creditors were demanding their money, and Abdul Ahemad saw no way out but to sell the buffalo. Money from the sale would pay off half his debts and allow him to buy rice for his family.

Other Productive Assets

The ethnographic work conducted during this study showed that ownership of other productive assets could either contribute to the food security of the household or destabilize it. In general, the effect depended on whether the asset allowed the household to rise out of debt or 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. To cover the remainder she took out a loan. Annapurna's chile-grinding business was soon providing regular income. Within a short 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 work out so well, however. Krishnayya, a well digger from Aurepalle, used Rs 10,000 in savings to purchase a crane. The crane could be used to remove mud from hand-dug wells. Although he could earn about Rs 1,200 for each well contract, Krishnayya miscalculated the demand for the crane as well as the cost of paying a team of laborers to work it.

[12]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 at the outset. During the 1992/93 agricultural year, the going rate for an attached laborer was Rs2,000–3,000 per year (roughly US$700–1,000). In Aurepalle, this arrangement is called *jeetam*. In Shirapur, it is called *chakari*.

As a result, the crane sat idle and his other debts, totaling Rs 1,700, went unpaid. He took out another loan to buy some dryland, but the poor rains meant no harvest that year. Later Krishnayya was forced to migrate to the city to repay his debts.

Liquid Assets: Small Livestock, Jewelry, and Roof Tiles

The villagers of Aurepalle and Shirapur also invested in items that could be liquidated rapidly and without trouble. The most common asset in this category was small livestock, 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 loans for buying goats were available for those below the poverty line (BPL). If someone 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 one year. After the animal had two offspring, the rearer and the owner each took one and the mother was 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." When 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 liquid assets, a few households used other goods as short-term deposits for their wealth. In both villages, households often sold a woman's jewelry when a crisis occurred. For example, Vimal Potdar, a landless woman in Shirapur, had to cope with the costs of a sudden illness. She took out 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

This study's 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 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 she did not know how to repay these loans. Almost certainly, they will use a system of *adal-badal* (literally "exchange") to repay, which means they 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* (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 owe money at several stores in the village. In Shirapur, for example, Krushnabai (the landless widow) explained, "We don't have lump-sum amounts to buy groceries or pay back the credit at once." Instead, she bought on credit from two or three grocers at once, each of whom allowed her only a small amount of credit. Krushnabai also juggled her daily food expenses in this way, even though she remained in an endless cycle of debt. The situation was similar for Sabera, an elderly woman who along with her husband presided over a landless family. To make their living, they took out a large lump sum loan and gave the money to another farmer. In exchange, they were allowed to cultivate the land for five years. However, because they were responsible for repaying the loan, they had to sell a portion of the crop. Expenses were tight, so Sabera had a balance due at three different grocery shops. When the first shopkeeper refused to give her family credit, she got credit at a second one. When the same occurred there, she received credit from a third and saved money to repay the first grocer.

Poor households also took out loans from local moneylenders at high interest rates. Often, the interest amounted to as much as the principal. Pedda Belanna, for example, took out a loan for Rs 312. After four years, the interest and principal amounted to Rs 650.

Villagers sometimes took out large loans from banks or cooperatives but more often avoided these sources because 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. There, 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 harijan case study family, was "drenched" in debt and finally had to migrate from the village because he had no 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 averse and 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. Some, however, made bad choices given knowledge about the local agroecological conditions. In Aurepalle, castor (a cash crop) and sorghum (a food crop) were common choices among the poorer farmers. Raju Maisayya, a small farmer from Aurepalle, however, gambled on good rain and planted cotton in the year of the study. But rainfall was erratic, and the cotton did not grow well. His family had urged him to grow either caster or sorghum because both grow well in dry, low-input conditions. Investing in cotton, his wife said, was "like throwing money on plants" (*"chetla pal"*). In Shirapur, Dyaneshwar Patil adopted the risk-minimizing strategy of farming with a partner and choosing a crop that required little water. In the year of this study, they grew only sorghum; Dyaneshwar expected that as much as 50 percent of the crop would fail owing to lack of water. Many other dryland farmers in Shirapur followed a similar strategy.

In contrast, among the households that owned land, those who were able to grow risky cash crops were comparatively food secure. Digamber Gharbude, for example, had once worked as an attached laborer for three to four years and saved enough to dig a well. The family had irrigated its land and increased its income dramatically. Ten years later they no longer had to buy grain or substitute inferior-quality hybrid sorghum for the preferred local varieties. Aside from sorghum, they were able to take on riskier cash crops such as chilies, onions, corn, groundnuts, chickpeas, red gram, and sugarcane.

The main difference affecting 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. Those that were not food secure had to avoid risk, that is, plant a crop that would grow under favorable or harsh conditions. In both villages, households appeared to base their choice of crop on the likelihood of failure, not the potential profits should the crop succeed. 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 in 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 supported her disabled husband, depended almost entirely on wage work but could not always get it (see Profile 1). Because of 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 that time work was abundant, and they were paid in-kind wages. Conversely, the months preceding the harvest were 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 forgo wage work to look after their sick children.

Attached Laborers

Villagers in Aurepalle and Shirapur agreed that families with members who worked as attached laborers (*jeetam* or *chakari*) were usually food insecure. In Shirapur, villagers reasoned that "no one became a permanent servant unless they were desperate" (*"nad aslekich chakari dharato"*). In times of crisis, families became attached laborers to earn lump-sum amounts to pay off loans, while still ensuring a minimum supply of food. Shaik Abdul Ahemad, for example, needed a

Profile 4: "Even a sinking person would try to hang on to a small stick."

Landlessness, debt, unexpected sickness, and social obligations work together to create a situation of food insecurity.

Nandishilor's family had always been poor, so poor that when it came time for him to seek a bride, no one was willing to "make an alliance" with him. Once, while in Pune, he met Vimal. She was also very poor. Because they were both poor and unmarriageable, they decided to marry each other. They live in Shirapur in a two-room house obtained from the Indira Gandhi Program. At first Nandishilor worked on a sand-carting truck, and Vimal did not work. Then 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. When distant relatives came to visit, Nandishilor felt obliged to offer them gifts and good foods. The sweets and clothes were purchased on credit and, four years later, the debt had 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 because their in-kind earnings were not enough to make ends meet. To supplement their income, Vimal raised a couple of hens to buy *mith-mirchi* (daily groceries). The children demanded the food they were once accustomed to eating, but Vimal could not provide it. They both saw that their children had lost weight.

Vimal said they had passed many nights crying together. Nandishilor felt guilty because he could not feed his family enough and his wife had to start working. Their children looked after themselves and stayed outside the house the entire day. "What to do?" she remarked; her wages are their sustenance. Vimal lamented to the 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.")

planned to butcher one of their four chickens when their relatives visited. "We have to provide a nice meal for guests. . . . It is our custom," she said.

For the rich, these obligations were not a problem, but for families living on the margin, such expenses often provoked a cycle of debt from which they could never escape (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 then lost weight, and he admitted the spending might have been foolish. "The guests may have forgotten the gifts *[aher]* that were given them, but we are still suffering in living hell *[narakwas bhogato]*."

Holidays and Religious Obligations

Even the poorest case study households expressed a need to celebrate holidays with new purchases and to fulfill religious obligations. In Aurepalle, Chinnama's family often borrowed food or grain from neighbors or shopkeepers. Yet the previous year, her husband, Sayalu, had taken out a loan from the cooperative bank. The loan was supposed to be used to fund income-generating activities, but 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 believed she could not ask for food because she was not working, explained that she had recently bought an "urban-looking" outfit for her infant granddaughter. It was the baby's first *marathi* new year (a regional holiday), and Krushnabai wanted it celebrated properly.

Aside from holidays, some of the poor case study households went to 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) planned 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 would take out another loan and sell 20 goats. His wife seemed very proud of these actions and said that during the celebrations at the new temple, her husband would "get God inside of his body."

6

Results of the Quantitative Methods

During the course of this study, several quantitative methods for evaluating each indicator were considered. This chapter first outlines the choice of method for indicator evaluation and then presents the results of a quantitative assessment of the candidate indicators. It concludes by using a simulation to illustrate the potential savings associated with a targeted food distribution program.

Issues Concerning Choice of Method for Indicator Evaluation

The biostatistics literature suggests 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, it was necessary to consider options for setting the critical value for determining statistical significance. No parallel examples exist in the literature because (to our knowledge) no study of indicators has attempted an analysis of more than a handful of indicators. Rather, most quantitative analyses have limited the set of candidate indicators to a small number (usually fewer 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, it was 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 is extremely broad because it includes all factors affecting 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 thus are rarely compared.

Second, different forms of the same indicators were tested. Although seemingly redundant, this search was done for practical purposes: food program practitioners cannot always collect the exact data they require. Instead, they must often use existing secondary data sources. To reflect these constraints, multiple formulations of some indicators were tested to determine if the formulation affected its performance. For example, several formulations of the dependency ratio were tested to determine how sensitive an indicator's performance might be to its formulation.[15] In addition, certain continuous variables were dichotomized, and both the dichotomized variable and the continuous variable itself were tested. For example, a dichotomous variable—"at least one preschooler sick with diarrhea" —was constructed from a variable that gave the number of preschoolers in the household that had diarrhea. Both variables were tested to determine if anything could be gained from collecting a continuous variable rather than a simple dichotomous one.

The typical limitations on data availability also suggested that it is important to investigate whether an indicator performs equally well at all times of the year. Does it matter, for example, at what time of year the data that target the chronically food insecure are collected? Are data from one season just as effective as

[15]The versions of the dependency ratio tested were dependency ratio 1 = (number of children + number of preschoolers)/household size; dependency ratio 2 = number of preschoolers/household size; dependency ratio 3 = number who cannot work/household size; dependency ratio 4 = (number of children + number of preschoolers)/(household size – number of preschoolers); dependency ratio 5 = number of preschoolers/(household size – number of preschoolers); dependency ratio 6 = number who cannot work/(household size – number of preschoolers); dependency ratio 7 = (number of children + number of preschoolers)/(household size – number who cannot work); dependency ratio 8 = number of preschoolers/(household size – number who cannot work); dependency ratio 9 = number who cannot work/(household size – number who cannot work); dependency ratio 10 = household size/(household size – number who cannot work).

Table 7—Relationship between the number of indicators tested and the critical chi-square statistic needed to determine a significant relationship between benchmark and alternative indicators

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	Approaches infinity

data collected in another? To answer these questions, indicators were collected in three seasons, and each was tested for its association with chronic food insecurity. If an indicator performed equally well across the seasons, that implied the timing of indicator collection was not important. This information would be especially useful to organizations with limited data collection budgets.

These three factors encouraged us to test the performance of a large number of alternative indicators. A review of the literature revealed more than 450 variations of food security indicators that could be tested in this study. These became the core set of alternative indicators (see list in Chung et al. 1996, Appendix 7). The large size of the set, however, presented a number of methodological problems. First, the test for significant association between the benchmark and the more than 450 core indicators necessitated multiple statistical comparisons. Repeating the same experiment several times increases the possibility of obtaining a high number of significant associations that result purely from chance. The chance of making such an error can be reduced by 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 benchmarks and alternative indicators is maintained at some fixed level of significance (say, $\alpha = .05$).

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-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 7). Between 11 and 50 indicators, it rises to 10.83.[16] Beyond 50 indicators, the additional correction rises rapidly, making it extremely unlikely that any indicator will clear the Bonferroni-corrected chi-square value.

The multiple comparisons problem illustrates the large statistical cost of 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, the sample was split 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[17] 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

[16]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. Reported here are the critical values associated with each range of probability levels given in the chi-square table shown in Rossner 1995.

[17]For analyses of the indicators of chronic food insecurity, 450 indicators were tested for each season, totaling more than 1,300 indicators.

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 in several tables described in the next section; they illustrate the range of results that are possible, given different requirements for indicator performance. While the group of double winners represents a group of indicators that succeeded under the least conservative criteria, 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 some indicators that are truly useful.

A Quantitative Assessment of Alternative Indicator Performance

A quantitative assessment of the performance of the alternative indicators is summarized in the tables presented in this section. 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. Because so many indicators were tested, only the performance of selected indicators is shown. Each table reports the chi-square statistics for indicators that either (1) passed the first screening test for significant association with the benchmark (chi-square > 3.84) or (2) are commonly collected in field surveys and often used as proxies for low economic status.[18] The last two columns show whether the alternative indicator met either the Bonferroni or double-winner criteria.

The results were somewhat surprising. Few indicators succeeded, even by the less conservative, double-winner criteria. Fewer still succeeded in the household-level analyses, and none succeeded at the preschooler level. The tests identified very few indicators of vitamin A deficiency and none of iron deficiency.

Chronic Household Food Insecurity

For this analysis, a household was defined as chronically food insecure if its "caloric adequacy" fell below 70 percent in four of the six dietary visits over the course of the study.[19] The choice of 70 percent as the benchmark cutoff was based on a calculation of the energy required to sustain a minimum-activity lifestyle.[20] Under this definition, approximately 32 percent of all households studied were chronically food insecure.

The results of the chronic household analyses are shown in Table 8. Several alternative indicators showed a strong association with the benchmark for chronic

[18]Among this group are 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.

[19]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 totaling the nutrient contribution of each ingredient identified during the diet survey and 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." In the academic nutrition community in India, the reference person is usually taken to be a 60-kilogram man of moderate activity (ICMR 1994). Adding up the total nutrient intake by the household and dividing it by the 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.

[20]Seventy percent of the recommended energy intake for the reference person is chosen because this figure represents the energy requirement for a low-activity existence. More specifically, estimates of energy requirements (ICMR 1994) were

Table 8—Performance of selected alternative indicators of chronic household 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 of testing								
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	No	No
Frequent consumption of buns or 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 percentage 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, r1	0.17	93	97	0.73	107	196	No	No
High dependency ratio 2, r1	2.72	118	97	2.92	113	196	No	No
High dependency ratio 10, r1	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	No	No

Notes: χ^2 = chi-squared statistic; Se = sensitivity; Sp = specificity; n = number of observations; r1 = round 1, late *kharif* season; and r2 = round 2, post-rainy season; r3 = round 3, late summer/early *kharif* season.

household food insecurity. None, however, showed a significant association with the benchmark in every season.

The indicators that showed the strongest performance (that is, met the Bonferroni criteria) came from the household food frequency questionnaire;[21] as such, they represented information about the frequency of consumption of various foods. Although 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 ran counter to this logic. First, most of the indicators that proved successful in locating the food insecure represented "more frequent" consumption of highly income-elastic foods, such as fats, oils, nuts, sugar, wheat, and processed cereal foods (buns or bread).[22] Food-secure families were expected to be more likely to consume these foods than food-insecure families. Yet, only one dietary indicator appeared to be consistent with economic theory; "infrequent consumption of meat" was statistically correlated with chronic food insecurity. In addition, most of these counterintuitive dietary indicators appeared more successful at identifying the food insecure than those suggested by the conventional poverty literature (for example, indicators representing household expenditures, demographics, landholdings, and caste).

Previous analyses of the dietary data were helpful in interpreting these counterintuitive results. A recent study on dietary patterns split the sample by state (Maharashtra and 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 9): the villages in Maharashtra (Shirapur and Kanzara) consumed more sorghum and wheat than the villages in Andhra Pradesh (Aurepalle and Dokur). In addition, households in the Maharashtran villages typically consumed more fats, oils, nuts, and sugar.

The set of dietary indicators shown in Table 9 mirrors the dietary trends shown in Table 8. When taken together, the set of successful dietary indicators described the Maharashtran diets relative to the Andhran diets; Maharashtran diets were higher in sorghum, wheat, oil, sugar, and nuts relative to the Andhran diets. As a result, the joint performance of these dietary indicators was taken to be more representative of location than any causal pathway involving any one of the foods per se. Each significant food consumption variable, in effect, acted as a proxy for a location or geographic indicator. The performance of the "Shirapur village" indicator in identifying the chronically food insecure supported the plausibility of the geographic indicators.

Aside from the Shirapur and food frequency indicators, the only other successful indicator was the number of preschoolers in the household. This indicator, however, succeeded during only 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, this indicator is not likely to be a robust indicator of chronic household food insecurity. The lack of robustness in a relatively structural indicator (one that is not expected to change in the short term) suggests that this double winner may, in fact, have been a random winner in both rounds of testing.

Acute Household Food Insecurity

The analysis of acute food insecurity focuses on abrupt changes in household caloric adequacy. To construct a benchmark of acute household food insecurity, households that plunged from a state of food security into a state of food insecurity were identified by defining two points between which changes in food security status could be assessed. In the region of the study, seasonality varies among the villages, but round 3 (late summer) is a lean season for all. During this time, the rains have not yet begun and little work is available. Therefore, the period between round 2 (the post-rainy season) and round 3 (late summer, early *kharif* season)

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applied to a pattern of activities that would represent a life of minimal activity, that is, energy needs for basic physiological demands (8 hours sleeping, 1 hour walking, and 15 hours standing or sitting quietly). For this pattern of activity, a calorie requirement of 2,015 kilocalories per adult equivalent was calculated. In turn, 2,015 represents approximately 70 percent of the 2,875 kilocalories necessary to support the reference person. Seventy percent of the requirement for an adult equivalent was therefore chosen as the cutoff for food insecurity.

[21]More than one type of questionnaire was administered to collect dietary information (see Table 5). 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.

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

Table 9—Energy sources by location of village and type of food

Village and food group	Energy intake per adult equivalent by expenditure tercile			
	1	2	3	Mean
	(kilocalories)			
Maharashtra villages				
Rice	53	83	96	77
Sorghum	946	1,092	1,047	1,028
Millet	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	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
Millet	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	2,344	2,408	2,314	2,356

Source: Chung and Bouis 1996.

was a good time to assess acute changes in food security.

To construct a benchmark of acute household food insecurity, we defined a household as acutely food insecure if (1) its household caloric adequacy ratio dropped below 70 percent between rounds 2 and 3 or (2) its caloric adequacy ratio was already below 70 percent in round 2 and dropped 10 percent or more in round 3.[23] Indicators collected in round 2 were tested for their ability to predict a fall into food insecurity during round 3.

Table 10 shows the results of the acute household food insecurity analyses. Several alternative indicators showed a strong association with the benchmark of acute household food insecurity. Among the strong performers were the food frequency indicators representing frequent sugar, sorghum, fats, and wheat consumption. As with the chronic indicators, the joint performance of these dietary indicators was interpreted as representative of location rather than any causal pathway involving any one of the foods per se: each of these indicators acted as a proxy for a location or geographic indicator.

Two other alternative indicators also 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 reflected be-

[23]If the second criterion was not included in the definition, then households with caloric adequacies below 70 percent in round 2 would be classified as food secure even if they dropped further in round 3 because the drop below 70 percent did not occur between the two rounds.

Table 10—Performance of selected indicators of acute household 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 of testing								
High percentage of foods consumed from gifts, r2	5.50	126	97	4.92	118	193	Yes	No
High number of foods consumed obtained on weekly basis, r2	4.08	124	97	8.33	124	194	Yes	Yes
Frequent consumption of nuts and oilseeds, r2	8.22	133	97	1.38	110	196	No	No
Frequent consumption of tea with milk, 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 consumption of fats and oils, 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 percentage of 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 with 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	1.72	116	97	0.54	107	196	No	No
High dependency ratio 10, r1	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: χ^2 = chi-square statistic; Se = sensitivity; Sp = specificity; n = number of observations; r1 = round 1, late *kharif* season; r2 = round 2, post-rainy season; r3 = round 3, late summer/early *kharif* season.

havior that is consistent with what one would expect 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 (presumably because wages are paid once a week in these villages). These findings were 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 could predict which households would fall 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 Food Insecurity

For this analysis, a preschooler was defined as chronically food insecure (PCFIS) if the Z-score for height-for-age was below –3.0. This cutoff corresponded to the bottom 30 percent of the sample's distribution of height-for-age data. 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.

Table 11 provides the results of these analyses. Most striking is the fact that none of the household-level alternative indicators successfully identified PCFIS. Two of the alternative dietary indicators (frequent consumption of oils in rounds 1 and 2) were screened as potential indicators in the first round of testing but appeared to be random winners because they failed to perform in the second round of testing. None of the more conventional poverty indicators performed well at identifying PCFIS.

Acute Preschooler Food Insecurity

Preschoolers were defined as acutely food insecure (PAFIS) if they fell among the worst 30 percent of preschoolers based on a drop in their weight-for-height Z-score between rounds 2 and 3. The drop corresponds to a difference of 0.4 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 12). In addition, none of the more conventional poverty indicators performed well at identifying food-insecure preschoolers.

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 were based on serum measurements of vitamin A and hemoglobin. Samples were collected from preschoolers and women in Aurepalle and Shirapur villages in two different seasons.[24] Because the 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 13 and 14 provide an overall picture of vitamin A and iron status in the study area. Mean levels of serum vitamin A are shown in Table 13. For women, serum vitamin A showed a significant decline between the late *kharif* season (round 1) and the late summer season (round 3). No significant difference appeared between the villages in the incidence of vitamin A deficiency of preschoolers or women.

Table 14, however, shows that iron deficiency is clearly a serious problem in both Aurepalle and Shirapur.[25] In Aurepalle, more than 60 percent of preschoolers fell below the World Health Organization (WHO) cutoff for anemia in both rounds (WHO 1972). For women, 47 percent were anemic in round 1, but iron status fell in round 3, leaving 75 percent of the women sampled anemic. In Shirapur, anemia values also rose in round 3. In round 1, 57 percent of the women were anemic; by round 3, 81 percent were anemic. Preschooler values followed a similar trend: 65 percent were anemic in round 1, worsening to 84 percent in round 3.

Such high rates of anemia and vitamin A deficiency are characteristic of these parts of South Asia (ACC/SCN 1992). Food aid programmers may therefore be interested in identifying households with micronutrient deficiencies. However, programmers may be hindered by their capacity to collect individual-level

[24]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.

[25]Iron deficiency was assessed with measures of hemoglobin. Hemoglobin concentration is one of the most widely used methods of screening 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 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 of testing								
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 percentage 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	6.63	127	119	0.06	103	234	No	No
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	2.46	85	122	0.59	94	241	No	No
High dependency ratio 10, r1	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: χ^2 = chi-squared statistic; Se = sensitivity; Sp = specificity; n = number of observations; r1 = round 1, late *kharif* season; r2 = round 2, post-rainy season; r3 = round 3, late summer/early *kharif* season.

Table 12—Performance of selected indicators of acute 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 of 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 dependency ratio 7, r2	8.61	132	75	1.50	111	154	No	No
Low dependency ratio 1, r2	5.67	130	75	0.92	109	154	No	No
Low dependency ratio 4, r2	5.48	126	75	0.93	109	154	No	No
Low dependency ratio 8, r2	4.37	124	75	1.27	113	154	No	No
Low dependency ratio 10, r2	4.00	112	75	1.07	110	154	No	No
Low dependency ratio 3, r2	4.00	122	75	1.07	110	154	No	No
Low dependency ratio 9, r2	4.00	122	75	0.09	104	154	No	No
Low number of agricultural workers	5.84	132	75	0.17	105	152	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	3.06	120	75	3.24	116	136	No	No
High dependency ratio 10, r2	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: χ^2 = chi-squared statistic; Se = sensitivity; Sp = specificity; n = number of observations; r2 = round 2, post-rainy season.

Table 13—Serum vitamin A levels of women and preschoolers

Village	Round 1: late *kharif* season				Round 3: late summer season			
	Mean	Standard deviation	Percentage below cutoff[a]	Number of subjects	Mean	Standard deviation	Percentage below cutoff[a]	Number of subjects
	(micrograms/deciliter)				(micrograms/deciliter)			
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[c,d]	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[c,d]	10.1	14.0	43

[a]Acceptable level of serum vitamin A as determined by National Health and Nutrition Examination Surveys (NHANES II) in 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 14—Serum hemoglobin levels of women and preschoolers

Village	Round 1: late *kharif* season				Round 3: late summer season			
	Mean	Standard deviation	Percentage below cutoff[a]	Number of subjects	Mean	Standard deviation	Percentage below cutoff[a]	Number of subjects
	(grams/deciliter)				(grams/deciliter)			
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[b,c]	1.6	81.4	43

[a]Acceptable level of blood hemoglobin—that is, the cutoff for anemia—as defined by the World Health Organization (WHO 1972).
[b]Significant difference between blood hemoglobin levels in Aurepalle and Shirapur.
[c]Significant decline in blood hemoglobin values between seasons.

measurements. To address this constraint, the micronutrient indicator analyses focused on testing the association between the core set of alternative indicators and two different micronutrient benchmarks, both of which were defined at the household level. Separate analyses were undertaken for each micronutrient in each season. For the vitamin A work, a household was considered vitamin A insecure if at least one woman or preschooler in the household fell below the WHO cutoffs. A similar benchmark indicator was derived for household iron security. Households were considered iron insecure if at least one woman or preschooler in the household fell below the cutoffs defined in the National Health and Nutrition Examination Surveys (NHANES II) (Pilch 1985).

Constructing micronutrient indicators for the household level is a novel idea, given that individual-level serum measurements are already available. The strategy, however, is consistent with the idea of testing simple protocols for identifying targeting instruments. If successful, these analyses could make it easier for agencies to collect targeting data.

Vitamin A deficiency. The results of the late *kharif* season analyses (round 1) are shown in Table 15, and those of the late summer season (round 3) are shown in Table 16. For each analysis, the benchmark for vitamin A insecurity was a simple dummy variable indicating whether, during that round, a household contained at least one woman or preschooler with vitamin A deficiency as determined by the NHANES II cutoffs (Pilch 1985).

For the late *kharif* season (round 1), a number of alternative variables succeeded in the first round of testing (Table 15). 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 two of the screened indicators qualified as double winners: households with a high number of preschoolers and households with at least one preschooler sick with diarrhea in the last 14 days.

For the late summer season (round 3), few alternative indicators succeeded in the first round of testing (Table 16). 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.

The vitamin A analyses produced few indicators. Yet the two that did succeed related to a plausible causal pathway. Households with many preschoolers and households containing preschoolers with diarrhea appeared more likely to include vitamin A–deficient women and children. These indicators followed logically from what is known of (1) the competition for care and proper nourishment within households with many preschoolers and (2) the linkages between morbidity and vitamin A deficiency. Note, however, that only the first of these indicators (a more structural indicator) was robust across seasons. In contrast, the second indicator appeared to be more season-specific. Given that sickness is more prevalent during the period following the rain, the diarrhea indicator logically performed 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, for more expensive or labor-intensive forms of iron intervention, targeting may be appropriate. As such, the possibility of developing alternative indicators of iron deficiency was explored. Again, because practitioners cannot always target at the individual level, we searched for household-level indicators that could identify households containing 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 one woman or preschooler who was iron deficient (as determined by the WHO anemia cutoffs) (WHO 1972).

The results of the analyses of alternative indicators for iron insecurity in rounds 1 and 3 are shown in Tables 17 and 18, respectively. No successful indicators could be found for iron deficiency in either season.

A Comparison of Indicators Derived from the Two Methods

The indicators tested in the quantitative analyses were derived from a review of the food security literature as well as the qualitative work reported in Chapter 5. When both the qualitative and quantitative analyses were complete, three questions remained. How similar were the lists of successful indicators derived from each method? How did the indicators identified in the qualitative work perform when tested quantitatively? What did these results mean for indicator development and use?

Because this study required contemporaneous information from the qualitative and quantitative sections, the two data collections were launched simultaneously. However, doing so meant that it was not possible to use the information derived from the

Table 15—Performance of selected alternative indicators of vitamin A insecurity, round 1

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 of 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	3.04	131	45	0.43	112	75	No	No
High dependency ratio 10, r1	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: χ^2 = chi-squared statistic; Se = sensitivity; Sp = specificity; n = number of households; r1 = round 1, late *kharif* season.

Table 16—Performance of selected alternative indicators of vitamin A insecurity, round 3

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 of testing								
Number of preschoolers in household, r3	3.89	143	44	3.89	130	71	Yes	No
At least one preschooler sick with diarrhea in the last 14 days, r3	4.56	141	43	8.23	139	71	Yes	Yes
High number of household members unable to work, r3	4.47	143	44	0.13	108	71	No	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	0.47	119	44	0.13	116	71	No	No
High dependency ratio 10, r3	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: χ^2 = chi-squared statistic; Se = sensitivity; Sp = specificity; n = number of observations; r3 = round 3, late summer/early *kharif* season.

Table 17—Performance of selected alternative indicators of iron insecurity, round 1

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 of 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 percentage 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
Other 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	7.15	143	45	0.00	96	75	No	No
High dependency ratio 10, r1	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: χ^2 = chi-square statistic; Se = sensitivity; Sp = specificity; n = number of observations; r1 = round 1, late *kharif* season.

Table 18—Performance of selected alternative indicators of iron insecurity, round 3

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 of 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	0.13	112	44	0.30	116	71	No	No
High dependency ratio 10, r3	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: χ^2 = chi-square statistic; Se = sensitivity; Sp = specificity; n = number of observations; r1 = round 1, late *kharif* season.

Table 19—Indicators of chronic food insecurity suggested by the qualitative work that were also tested quantitatively

Indicators of household chronic food insecurity identified by qualitative techniques	Corresponding indicator from the survey that was tested quantitatively
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
Attached laborers	Household has a member who works as an attached laborer
Few income earners in a large family	Dependency ratio (10 formulations)
Purchases staple grains more than once a week	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

qualitative work to inform the design of the survey. Therefore, 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 were tested quantitatively. These indicators are shown in Table 19.

None of the indicators listed in Table 19 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?

The primary explanation points to a difference in the methods. The quantitative analyses tested single indicators. In the qualitative work, however, villagers identified a number of reasons why a household was food insecure. During the qualitative exercises, the research team asked the villagers to identify the households that "constantly struggle to feed their members," then probed for the reasons 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, gave two or three reasons. The ethnographic reports of families also suggested that a combination of factors rather than any single factor 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. This hypothesis could be tested with a stepwise logistic regression, using the core set of quantitative indicators. Once the stepwise regression was complete, the resulting set of quantitative indicators could be compared with that derived in the qualitative results.

A second reason may explain the lack of overlap between the qualitative and quantitative results. The quantitative study identified relatively few successful indicators. That low number might at first suggest little potential for alternative indicators or, at least, for indicators used singly. However, further statistical tests showed 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 (that is, may not find a statistical association between an alternative indicator and the benchmark) when, in fact, it should. 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 of the two-by-two contingency tables indicate that a vast majority of the chi-square tests were conducted under conditions of low power. The implications are clear: it is relatively certain that the indicators identified as winners are indeed good indicators of the benchmarks. However, it is less certain that losers identified by the same process are truly losers. Under conditions of larger sample sizes, significant associations might have been found. As a result, the quantitative results most likely understate the number of statistically valid alternative indicators.

Finally, the lack of overlap between the qualitative and quantitative results may simply reflect the differen-

ces between local and outside perspectives on food security. The qualitative approach anticipates that emic and etic perspectives will diverge; there is no dictum stating that researchers and local people fundamentally view food security in the same way. Thus, even under the best of research conditions, divergent results should not be considered a sign of a "failed" study.

Using Targeting Indicators to Improve Program Efficiency

A number of simulations are presented here to illustrate the potential benefits of using the targeting indicators identified as "winners" in this chapter. The benefits associated with an indicator will vary, however, according to how it is used to improve the cost-effectiveness of a program. Therefore, 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 scenarios under which targeting might be used to improve the efficiency of a program:

1. *Fixed-budget scenario:* Programmers have a fixed budget and can thus serve a limited number of participants. Targeting is used to improve the identification of truly food-insecure households and thus to increase the proportion of participating households that are truly food insecure. Since the total budget of the program remains fixed, the number of participant households does not change. The change occurs in the composition of the participant group.
2. *Fixed-coverage scenario:* 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, but the total number of truly food-insecure households that are served remains the same.
3. *Variable-benefits fixed-budget scenario:* Programmers serve the same number of truly food-insecure households as in an untargeted intervention but use targeting to decrease program leakage. The total budget remains the same, but the value of goods or services provided to each 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 such cases, most participants are truly needy and efforts to improve targeting are likely to have only a marginal benefit. In addition, because collecting and acting on targeting data incur costs, a targeted program could be less cost-effective than an untargeted program.

If, however, the prevalence of food insecurity is relatively low or a program aims to serve 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 likely include a high proportion of participants who are not truly food insecure and, therefore, experience 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. Targeting indicators can then be a powerful tool for reducing program costs and maximizing social impact.

Targeting to Reduce Program Leakage

Each of the indicators identified as double winners in the quantitative analyses is used here to illustrate the potential reductions in program leakage that can be achieved with targeting. Table 20 presents a comparison of the benefits of targeting using alternative indicators with the untargeted case, under both the fixed-budget and fixed-coverage scenarios.[26] In the untargeted situation the proportion of truly food-insecure participants is assumed to be equal to the proportion of food insecurity in the total population. In this simulation, the proportion of true positives and false positives obtained from targeting with each indicator is compared with no targeting. 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 20 shows the percentage increase in the number of true positives included in the program (that is, truly food-insecure participants) as a result of using a targeting indicator. Column 2 shows the percentage 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

[26]Because the variable-benefits scenario is similar to the fixed-budget scenario in terms of its impact on program leakage, an analysis of this scenario is not presented in Table 20.

Table 20—Benefits from targeting with selected indicators, compared with no targeting

Indicator	Fixed-budget scenario		Fixed-coverage scenario	
	Percentage increase in true positives	Percentage reduction in leakage costs	Percentage reduction in budget	Difference in budget reduction compared with most successful indicator[a]
				(US$)
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[b]	0
Frequent consumption of fats and 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[b]	0
Frequent consumption of tea with milk, r2	42.6	12.2	29.9	88,983
Frequent consumption of sugar, r2	47.0	13.5	32.0	67,945
Frequent consumption of fats and oils, r2	40.7	11.7	28.9	98,370
Frequent consumption of wheat, 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	. . .
Vitamin A deficiency, r1				
Number of preschoolers	57.9	19.6	36.7	126,667
Preschoolers with diarrhea	97.4	33.0	49.3[b]	0
Vitamin A deficiency, r2				
Number of preschoolers	80.1	20.6	44.5	44,311
Preschoolers with diarrhea	95.7	35.0	48.9[b]	0

Notes: This analysis assumes a program size of 100,000 participants and a per capita cost of US$10, for a total assumed budget of US$1 million. Leaders (. . .) = not applicable; r1 = round 1, late *kharif* season; r2 = round 2, post-rainy season; r3 = round 3, late summer/early *kharif* season.

[a]Based on given assumptions of program size and cost structure. This amount is the minimum difference in data collection costs that allows the indicator to be more cost-effective than the most successful indicator for each analysis.

[b]Most successful indicator (that is, indicator that produces the greatest budget reduction) for each analysis.

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 that will be treated in more detail later.

Under the assumption of a fixed budget, the results from Table 20 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 acute preschooler food insecurity and as much as 97 percent in the case of vitamin A deficiency (based on data from round 1). Given the relatively low prevalence of household-level vitamin A deficiency in the sample (28 percent) and the resulting high potential for leakage from an untargeted program, the results suggest that large returns may be possible from targeting on selected indicators. These returns result from improved coverage of the truly food insecure.

The fixed-budget scenario also suggests potentially large reductions in the costs of program leakage. Table 20 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 20 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 ranging from 21 percent (in the case of acute preschooler food insecurity) to 49 percent (in the case of vitamin A deficiency, round 1).

Given this set of program conditions, the results in Table 20 suggest that certain indicators perform better than others in reducing program leakage. However, the correct criterion for selecting targeting indicators is the net program savings, that is, savings after subtracting data collection costs. Column 4 shows the difference between the budget reduction achieved by each indicator and the reduction achieved by the most successful indicator. This amount represents 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 (that is, 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 "infrequent consumption of meat, r2" 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 20). The next greatest reduction in program costs resulted from the indicator "frequent consumption of sugar, r3." Targeting with this indicator resulted in a savings of nearly 31 percent, or US$306,723. Column 4 shows the minimum difference in data collection costs that would equate the savings achieved using these two indicators. For this case, the difference is $29,712: the savings achieved using the sugar variable would be greater than those from the meat variable, as long as the sugar variable cost at least $29,712 less to collect. After that point, the meat variable would be more cost-efficient.

If the cost of collecting the two indicators was 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 cost of data collection was at least US$39,836 less than that of the meat consumption indicator.

These examples underscore the fact that the appropriate criterion for indicator selection is net savings. Note, however, that the amounts in column 4 result from 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 will likely change the relative performance of these indicators and the ultimate choice of the optimal indicator for targeting purposes.

Accounting for Social Costs

The results in the previous section describe how targeting can reduce program leakage and thus decrease program costs. That analysis, however, remains 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 both program and social 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 outperform another. Selecting an indicator boils down to determining whether a given range of social costs for one indicator is more realistic than the range associated with another indicator.[27] This assessment is not straightforward and may not always yield a single-best indicator for targeting purposes. Such a process, however, could identify a set of preferred indicators. An indicator in this preferred set could produce significant reductions in program and social costs relative to the untargeted case.

Another targeting simulation illustrates how the social costs of food insecurity might enter into the selection of a targeting indicator (see Table 21). For this exercise, it is necessary to make assumptions about program size, per capita intervention cost, and the cost of collecting each alternative indicator.[28] In this example, programmers are seeking an alternative indicator to identify chronically food-insecure households. The exercise assumes a program with a population of 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

[27]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 Chapter 3.

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

Table 21—Accounting for the social costs of food insecurity in assessing indicator performance

Indicator	Program costs (1)	Social costs of false negatives (2)	Total program and social costs (1 + 2)	Total cost savings compared with no targeting	Data costs required to match net savings from most successful indicator	Savings net of data costs
			(thousands)			
Chronic household food insecurity						
Scenario 1 (social cost = US$10/capita)						
No targeting	1,000	1,347	2,347	. . .	. . .	. . .
Live in Shirapur	1,000	1,224	2,224	123	61	62
No preschoolers	1,000	1,243	2,242	104	42	62
Infrequent consumption of meat, r2	1,000	1,185	2,185	162	100[a]	62
Frequent consumption of fats and oils, r2	1,000	1,231	2,231	116	54	62
Frequent consumption of sugar, r2	1,000	1,244	2,244	103	41	62
Frequent consumption of sorghum, r2	1,000	1,214	2,214	133	71	62
Frequent consumption of sugar, r3	1,000	1,197	2,198	149	87	62
Frequent consumption of fats and oils, r3	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	. . .	. . .	. . .
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 consumption of meat, r2	1,000	9,035	10,035	1,236	100[a]	1,136
Frequent consumption of fats and oils, r2	1,000	9,385	10,385	886	–250	1,136
Frequent consumption of sugar, r2	1,000	9,486	10,486	785	–351	1,136
Frequent consumption of sorghum, r2	1,000	9,254	10,254	1,017	–119	1,136
Frequent consumption of sugar, r3	1,000	9,135	10,135	1,136	0	1,136
Frequent consumption of fats and oils, r3	1,000	9,207	10,207	1,063	–73	1,136
Acute preschooler food insecurity						
Scenario 3 (social cost = US$10/capita)						
No targeting	1,000	1,124	2,124	. . .	. . .	. . .
Perfect targeting	1,000	405	1,405	719	200[a]	519
Household did not give gifts to other households	1,000	1,050	2,050	74	–445	519

Notes: Leaders (. . .) = not applicable; r2 = round 2, post-rainy season; r3 = round 3, late summer/early *kharif* season.
[a]Most successful indicator (that is, indicator that produces the greatest total cost savings) in each scenario. Data costs for this indicator are assumed, and data costs for other indicators are based on this assumption.

analysis of indicator performance under the assumption that the per capita social costs of food insecurity equal 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 (program plus social costs), as indicated in column 4 of Table 21. Again, the greatest savings came from the "infrequent consumption of meat" indicator. Because program costs are fixed, the savings from targeting are derived from the increased proportion of the food insecure 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 program plus social costs of a program targeted using the meat consumption indicator amounts to US$2,185,000 under the stated assumptions. Compared with the costs in an untargeted program of US$2,347,000, the use of the 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 equals US$100,000, the net savings from targeting using this indicator is US$62,000. Given that assumption, column 5 of Table 21 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 "frequent consumption of fats and oils" indicator can outperform the meat consumption indicator only if it costs less than US$54,000 to collect. At this level of data costs, the net savings from using the "frequent consumption of fats" indicator equals that from using the "frequent consumption of meat" indicator (see column 6).

Scenario 2 attempts to identify whether a level of per capita social costs of food insecurity exists such that no indicator can possibly outperform the meat consumption indicator. The results show that the social costs of food insecurity would have to rise only to US$76.25 per capita to clearly identify infrequent meat consumption as the optimal targeting indicator.[29] At this level, column 4 suggests that the savings (in terms of both program and social costs) from targeting on the meat consumption indicator would rise to US$1,236,000 compared with the no-targeting case. Again, the next greatest reduction in total costs would 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 meat consumption indicator are US$100,000, it is impossible for the 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, "infrequent consumption of meat" would be the optimal indicator.

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

Comparisons with "Perfect Targeting"

As stated previously, the use of the benchmark indicator in selecting candidates for program participation represents a case of "perfect targeting."[30] The search for alternative indicators for targeting purposes is therefore justified only if the benchmark indicators are considered unreliable or too costly to use in an operational context. For example, an indicator might be considered unreliable if it is subject to a strategic bias, that is, individuals perceive that some benefit might accrue to them if they misrepresent their personal information. Alternatively, the costs of collecting the data for a benchmark indicator might 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 compared with the performance of the benchmark itself, as well as with the no-targeting scenario. In spite of fairly high data collection costs, use of the benchmark indicator could still prove more cost-effective than any alternative.

Scenario 3 in Table 21 examines the performance of an indicator that was technically successful at identifying preschoolers with acute food insecurity. The indicator, "household did not give gifts to other households," is evaluated against the benchmark measure of child weight-for-height. The program assumptions are the same as those for the preceding scenarios: the program size is 100,000, the cost of an intervention is US$10 per capita, and the social costs of food insecurity equal US$10 per capita. In this scenario, the data collection cost of the benchmark (the perfect targeting case) is assumed to be US$200,000 (20 percent of the size of the program).

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[29]The figure US$76.25 was derived using an iterative process that set the social cost at a level such that the data collection costs of the alternative indicator (column 5) would have to be less than zero to outperform the meat consumption indicator, in terms of savings net of data 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 meat consumption indicator.

[30]Use of the term "perfect targeting" is not intended to deny the possibility of measurement error in the direct, benchmark indicator but only to imply that the benchmark is the best possible measure and the standard against which other indicators should be compared. The results reported in Table 21 suggest that the benchmark indicator would likely be preferable to alternatives, even in the case of fairly significant measurement error.

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 outperforms the benchmark indicator based on child anthropometry.[31] 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.

[31]Again, although 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 21 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.

7

An Evaluation of the Data Collection Process

One important goal of this study was to learn what difficulties are associated with each data collection method as well as what conditions 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, during a two-day conference in July 1993, the data collection teams—both qualitative and quantitative—spent one full day offering feedback 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 the participation of villagers to be desirable, feasible, and practical? More specifically, do participatory research methods empower respondents more than traditional research methods, or do participatory methods empower only the researchers? And can research be designed to incorporate local knowledge, share information with participants, allow respondents to benefit from findings, and generally improve the quality of policy and program conclusions?

Empowering the Villagers

Despite our best efforts, we concluded that the participatory research methods used in the study were no more empowering for the villagers than the survey methods. Therefore, the participatory methods are more accurately described as qualitative than as truly participatory.

The participatory methods, however, did help establish rapport with the villagers quickly. These methods are 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).

Although the villagers did not always determine definitions of key concepts used (for example, "energy expenditure" and "very high risk families"), the concepts needed for the project exercises were adapted to suit local needs. For example, the local way of expressing percentages in terms of the number of paise in a rupee was used frequently. Open-ended discussions allowed researchers to gain a better understanding of how emic (locally defined) perceptions differed from etic (defined by outsiders) ones. However, respondents still provided information on the researchers' terms, most often using the researchers' concepts expressed in local language. For these reasons we believe that the methods used were no more participatory than the survey methods employed. If this type of data collection must be distinguished from the survey, it is more accurately described as qualitative than as 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, 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 of Participatory Approaches

The participatory methods were not without their special problems. Because these methods were meant to

elicit participation in group discussions about village problems, they tended to raise expectations that the research group would initiate a village development program. Questions that seemed simple in theory—such as "Who in this village is hungry?"—were difficult to ask (let alone answer) in the field because 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 perception of potential benefits produced uncertainty in some women's groups about whether or not to identify some households as food insecure. This exercise often led to responses such as "Who isn't?" or "Everyone!"

The participatory exercises also presented the dilemma of facilitating the participation of different caste groups and women, while not alienating dominant groups. This dilemma could be resolved to some extent by dealing separately with different sections of the village as divided along 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.

Participatory methods are not necessarily rapid. Time was needed to establish rapport, play with children, help with chores, broach confidential topics with sensitivity, and encourage responses from shy or reluctant villagers. Each household exercise took more than an hour to complete (approximately equal to conducting a diet survey), and the group exercises took about two and half hours. However, participatory data are more transparent and less likely to require extensive computer entry and analysis.

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

Finally, the quality of participatory exercises relies heavily on the skills of the individuals conducting the exercises. Investigators must have a keen understanding of the objectives of the exercises and how to elicit information from villagers. They must be able to improvise and probe for clarifying answers. Furthermore, to make the process truly participatory, investigators must be given the opportunity to follow up 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. This section summarizes their perceptions on data collection under the various survey modules.

Three survey methods were used to discuss the dietary patterns of study households: 24-hour recall, food frequency, and food charts (on a subset of 40 households). Investigators compared these methods in a subjective manner (see Table 22). Although the methods cannot be compared objectively—the methods all have different purposes—tables such as Table 22, which was constructed by the nutrition investigators themselves, were extremely useful in deciding which indicators could be trusted and which could not.

The 24-hour recall survey proved most difficult to use with 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, as well as with the extended families, who had complicated eating arrangements.

Investigators expressed three concerns about expenditure modules. They thought that responses might differ according to whether the respondent was male or female. They found it difficult to ask respondents about sensitive expenditures that could account for a significant proportion of expenditures, such as cigarettes, alcohol, ganja, and lottery tickets. And the large number of food items necessary to get an accurate measure of total expenditures per capita (120 items) made this module difficult to complete in a timely manner.

When responding to the morbidity module, respondents generally did not consider symptoms such as colds, coughs, eye infections, and minor ailments sicknesses to be reported to the field investigators. At the other extreme, some women complained about body aches, knee pain, and leg pain they had experienced for at least 10 years. In certain cases, women were reluctant to discuss gynecological problems. Finally, disease and symptom terminology differed from village to village.

In the breast-feeding 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? Mothers had no trouble listing foods given to the child during the weaning period.

Table 22—Investigator perceptions of three methods of dietary analysis

Category	Food frequency	24-hour recall	Food chart
Time required for data collection	Less time consuming	Time consuming	Time consuming
From whom?	The person who does preparation and marketing	The person who does preparation	The person who does preparation and marketing
What does the method tell us?	Seasonal information	Only one day of information (hopefully representative)	Seasonal information
Quantification	No quantification other than frequency	Quantification	No levels, just proportions
Chance of missing food items	No chance, because of prompting	Some chance	Some chance
Confidence in quality of response	Confident about most items, not confident about a few items that are eaten rarely or occasionally	Confident about household consumption, not confident about individual consumption	Confident, but often quantity is confused with frequency, e.g., in the cases of sugar, oil, or *dhal*
Respondent's level of interest	Medium	High at the start (getting water volumes, etc.) but slowly diminishes	High
Respondent's sense of participation	Low	Partial	Complete
Respondent's ability to understand	Good at household level, good for pregnant and lactating women and mothers of preschool children	Good at household level, good for individuals who carry *tiffins* (lunch boxes), less easy for individuals who eat from a plate	n.a.

Note: n.a. = not available.

Table 23—Problems with questions on the food-security perceptions module

Question	Problem
If you had an extra Rs 100, what would you buy more of?	Respondents do not understand where the Rs 100 comes from.
Which three foods would your family like to eat more of?	Respondents interrupt to say that they have no preferences and no money, and they eat whatever they have to eat.
Is your family in poor health owing to a lack of healthy foods?	Respondents understand more readily if the same question is asked in a positive sense, i.e., do you think "healthy" foods are important in maintaining good health?
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.

The module on perceptions of food security was included to increase the qualitative nature of the survey and to elicit more information on respondents' own perceptions of hunger and food security. Some of the questions were straightforward: number of meals adult has per day, number of meals preschool child has per day, and so forth. Some questions proved difficult to administer. Table 23 highlights those questions.

8

Lessons Learned from This Study

This study presented two distinct methods for developing alternative indicators of food insecurity. The results of this study offer a number of lessons for choosing and using a methodology for developing alternative indicators.

Qualitative Methods at the Community Level

The work with qualitative methods in this study suggests they are a promising tool for small-scale organizations without 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. The qualitative work suggests that many indicators represent location-specific coping strategies; thus, 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 nongovernmental organizations that have long-term commitments to certain communities. These organizations can (and do) use many of the same types of participatory exercises used in this study, as well as the more traditional ethnographic methods, to develop community-specific indicators. In addition, organizations can 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. This study did not investigate locally determined combinations, but they are likely to be much more valuable than single indicators.

Indicators identified in a qualitative fashion can be validated over time using an NGO's "inside knowledge" of a community as well as the community's assessment of how the indicator is working to target the food insecure. Again, because of the location-specific nature of indicators, "successful" indicators can be used in different locations only with some sort of validation (quantitative or qualitative) in the new location.

The qualitative methods used were simple and feasible at the community level. They did not require large amounts of data entry or data analysis time. In each new situation, however, they will require adjustments. In addition, these approaches require investigators with solid training in ethnographic and participatory methods. Investigators must have the capability to leave behind preconceived notions regarding food security relationships. They must be able to learn about community perceptions of food security and observe patterns within the community. These skills were difficult to glean from traditional résumés, but they became more obvious when working with individuals in the field. So, while 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 field training exercises.

Quantitative Methods and Sample Size Issues

The method chosen for screening and testing the alternative indicators in this study was simple enough for a well-trained research analyst (or statistician) to carry out in-country. Determining the most appropriate analytical method and cleaning the data took the most time. If clean secondary data are available (for example, national census or Demographic and Health Survey data with benchmark indicators), then staff analysts can undertake the same statistical tests of association done for this study. If data must be collected and cleaned, however, 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, opportunities may exist to defray the costs of indicator development.

This study used relatively straightforward methods for identifying statistical association between the candidate indicator and the benchmark. Nevertheless, issues of sample size were important enough to render many of the tests of association statistically powerless.[32] The survey was not a small one; the sample of 325 households represented more than 17 percent of the total number of households in the four villages. Therefore, the quantitative methodology would work best for organizations with access to large data sets (that is, 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 alternatives and benchmarks (if they indeed exist).

This recommendation indicates that small-scale organizations may encounter analytical problems if they attempt the quantitative method reported here. Conversely, large organizations (with sufficient human resources and relatively large program mandates and data sets) will more likely have success with this method.

This recommendation necessarily reflects our experience with this particular data set. In theory, sample size calculations can be carried out at the beginning of any indicator study. However, it is difficult to estimate 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), a good theoretical basis exists for estimating the size of certain proportions and the difference between proportions that is (biologically) important. For social science indicators, analysts find these proportions difficult to predict and have considerable difficulty attaching meaning to the size of the difference in proportions. As a result, accurate sample size calculations are difficult to achieve with this type of data.

Data from other populations may not behave in the same way as the data represented in this study. Therefore, organizations using secondary data sets should first check if sufficient power exists to test the relationships proposed. Doing so ensures that any nonsignificant findings do indeed represent a nonrelationship between the alternative and the benchmark. For this study, this calculation showed that there was not adequate power to test several of the indicators. This finding does not invalidate the relationships that were identified. It only says that it is not clear whether an indicator was unsuccessful 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.

Lack of Overlap between Methods

The experimentation done here with quantitative and qualitative methods for indicator development found little overlap between the results derived from the two methods. Does that mean one method failed and the other one succeeded?

This particular experience should not be viewed as a failure of either method. Rather, problems with sample size in the quantitative survey and the inability to follow up quantitatively on the role of combination indicators made it difficult to directly compare the results from each method.

Does the lack of correspondence mean that the indicators suggested by the quantitative or qualitative method are not valid? There are at least two reasons why this may not be true. First, the lack of correspondence may reflect the fact that the statistical power was too low for most contrasts (determined largely by sample size) to properly test many of the indicators suggested by the qualitative study. Some indicators

[32]Pearson chi-square tests of independence were used to test the strength of the association between the benchmark indicator of food security and the alternative indicators. The null hypothesis for each of these tests is that the benchmark and the alternative indicator are statistically independent. Under the null hypothesis, the test statistic, chi-square, is asymptotically distributed as a chi-square random variable with one degree of freedom. Under the alternative hypothesis, the test statistic is asymptotically distributed as noncentral chi-square with one degree of freedom. In addition to the degree of freedom parameter, the noncentral chi-square distribution is characterized by a noncentrality parameter, which we refer to as λ.

To calculate the power of the tests, it is necessary to determine the value of λ so that the noncentral chi-square distribution will be fully specified. Following Agresti (1990), λ is calculated as a function of the probabilities under the null and the alternative of an observation falling into each of the four categories of the two-by-two table. The power for the test of independence is the probability that an observation from a noncentral chi-square distribution (with noncentrality parameter λ and one degree of freedom) lies above the critical value for this test. The critical value is determined by α (the significance level) of the test. The power was calculated using the software package S-PLUS® (Mathsoft Inc.), although tables and graphs exist that provide values for standard α levels.

might have been validated statistically if the survey had been larger. On the other hand, some might not have been validated, possibly meaning that villagers and researchers perceive food security differently. This study, in its present form, cannot say which indicators would have been validated by both qualitative and quantitative methods.

Beyond this statistical explanation, it is also expected that emic and etic interpretations of food security (and hence emic and etic indicators) may differ. In such cases, researchers may observe a lack of congruity between indicators identified by researchers (that are based on theory or empirical observation) and by local people (that are based on their own experiences with food insecurity). This lack of overlap should not be surprising and should not be viewed as a failure of the indicator-identification process. Rather, using qualitative and quantitative methods together allows researchers to identify elements of food insecurity that can be known only by those who experience it. Qualitative methods allow researchers to deepen their understanding of food security conditions and to tailor generic indicators to specific settings.

Complementary Methods

The recommendations made in the previous section are not meant to imply a lack of complementarity between qualitative and quantitative methods. Admittedly, small-scale projects may not find the quantitative method suggested to be useful. However, larger projects will find many opportunities to combine qualitative and quantitative techniques and improve the reliability of alternative indicators. Because this was a study of methods, the qualitative and quantitative sections were run simultaneously. However, a true indicator development exercise need not do so. Specifically, qualitative techniques can be used first to narrow down the list of candidate indicators. The quantitative analysis can follow, and the results can be validated using qualitative techniques in the field. Qualitative techniques may also be used in the interpretation of indicators that arise from the quantitative analysis. A keen understanding of the local context is important for the interpretation of indicators suggested by the quantitative analysis.

Combinations of Indicators

As previously stated, 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 the ethnographic observations made in this study. In most cases, households were food insecure when they exhibited a combination of disadvantageous factors. The lack of time and resources kept us from exploring the possibility of combinations in this study. 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: the number of combined indicators should not burden field personnel when they carry out the targeting.

Potential for Program Savings from Simple Alternative Indicators

Simulations using the indicators identified in the quantitative study showed that indicators with significant associations with the benchmark produced substantial savings in program costs. Alternative indicators that are feasible for use in the field can therefore reduce program leakages. The correct criteria for indicator selection, however, 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. 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.

Action-Oriented Follow-Up

Finally, despite our best intentions, the research-based participatory methods used in this study were no more empowering for the villagers than the survey methods. This is more a result of the objective of pursuing extractive data gathering for a predetermined research agenda rather than a failure of participatory methods per se. Qualitative techniques are truly participatory only when employed with action-oriented interventions.

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.* This study was limited analytically by the lack of

adequate power for the statistical tests. The same method should be attempted on a larger 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 the natural next step in determining the usefulness of alternative indicators. Combinations will strengthen the relationship between alternatives and benchmarks and better 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 insufficient size of the sample used in this study 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 local perceptions regarding food insecurity converge with the 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).* Again, the size of the sample precluded an accurate assessment of the strength of an alternative indicator relative to more conventional poverty indicators. Nevertheless, this difficulty 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.* As in items 3 and 4, sample size 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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