Measuring Mortality, Nutritional Status, and Food Security in Crisis Situations:

SMART METHODOLOGY

SMART
Standardized Monitoring & Assessment of Relief & Transitions

Version 1
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Make everything as simple as possible but not simpler.
—Albert Einstein (1879–1955)

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Contents

1 Background

The SMART Methodology Version 1 provides a basic, integrated method for assessing nutritional status and mortality rate in emergency situations. It provides the basis for understanding the magnitude and severity of a humanitarian crisis. The optional food security component provides the context for nutrition and mortality data analysis.

The July 2002 SMART workshop recommended (www.smartindicators.org) the development of a generic method that provides timely and reliable data in a standardized way for prioritizing humanitarian assistance for policy and program decisions. This is the first coordinated effort by the international humanitarian community to provide standardized data that is accurate and reliable for decisionmaking.

The SMART Methodology Version 1 draws from core elements of several existing methods and current best practices. Recommendations are based on varying degrees of evidence: 1) methods for which there is clear scientific evidence to support its recommendation, 2) practices that empirical evidence from field work suggest will lead to scientifically valid conclusions, and 3) practices that are considered reasonable and valid but for which more evidence is needed. In particular, the evidence for recommending the particular method for assessing mortality rate is limited, and there is need for more field experience and analysis. For nutrition, the method builds upon well-established methods. In particular, the Save the Children/UK *Emergency Nutrition Assessment: Guidelines for Field Workers*[2] and SC/UK colleagues provided the sound technical foundation for building a generic method that could be applied in all emergencies.

For food security, although there is not yet an agreed method or best practice, the Household Economy Approach (Livelihood Method) has worked well in predicting quantitatively how an event, such as crop failure or price change, is likely to affect people's ability to get food. It gives an estimate of who will be affected, how severely they will be affected, and when they will be affected. Other methods do not give this quality of information. In addition, the method developed especially for SMART Methodology Version 1 is the simplest, practical version of the Household Economy Approach that still provides the most essential data that can be collected alongside the nutrition and mortality survey.

A practical consideration that initiated the development of the SMART method, and guided the decision process in its development, is that nongovernmental organization (NGO) partners should be able to collect these data with ongoing nutrition surveys with a minimum of added burden to their programs. In addition, the method's level of difficulty is a conscientious balance between technical soundness and simplicity for rapid assessment of acute emergencies to obtain early, accurate, quantitative profiles of a population's nutritional status and mortality rate.

For these reasons, the SMART method is iterative, with continuous upgrading and building on this basic version, informed by research, experience, and current best

[2] *Emergency Nutrition Assessment: Guidelines for Field Workers*, Save the Children, U.K., 2004.

practices. For example, cause of death and other related indicators will be reviewed for potential inclusion in later versions. All partners and relief organizations are encouraged to use SMART Methodology Version 1 to inform this dynamic process and the research agenda. In countries where standardized methodologies are being used already, effort should be made to comply with the SMART method as far as possible.

Version 1 is not intended to be a comprehensive manual that covers all aspects of all surveys, nor is it meant to be inflexible. Efforts have been to provide detailed instructions where possible, yet allow sufficient flexibility to cover the many and varied situations that arise in the field.

Intended users are host-government partners and humanitarian organizations. Version 1 is intended as a practical tool that can be used by NGO field workers with technical support and training. The SMART Initiative is establishing a comprehensive capacity building and support system that will be accessible to all partners. This will expand the use of the standardized method among national and international agencies, improve data quality, and enable decisionmaking based on accurate data.

2 Introduction

The basic indicators for assessing the *severity* of a crisis are the mortality, or death rate, and the nutritional status of the population. These are both estimated by conducting a survey of the affected population.

To know the *magnitude* of the problem we also need to know the population size and, if possible, the demographic characteristics of the population. A high proportion of malnourished in a small population is normally of less magnitude than a lower proportion of malnourished in a large population. The scale and type of intervention will depend upon the magnitude of the emergency rather than simply on the prevalence of malnutrition.

To understand the reasons for the crisis and to plan and implement appropriate relief, the usual situation for that population, the evolution of the changes, and the context in which the emergency has arisen each needs to be considered. There are many sources of information that are relevant in putting the crisis in context and that may affect the types of response that are appropriate. Cultural, political, economic, anthropological, medical, nutritional, topographical, climatic, seasonal, and other factors can all be important. The effects of these factors on livelihoods and the ability of the affected population to cope at a household level are assessed using a food security survey.

To be useful, the information has to be relatively easy to collect, reliable, and accurate. This manual is designed to provide agencies with the basic tools to collect the data necessary for planning direct interventions in an emergency setting.[3]

The manual is divided into two sections: the assessment of nutritional status and death rates, and the examination of the food security situation.

These data should be collected from the same population simultaneously by conducting surveys. The data are then integrated with estimates of the population size to provide an overall picture of the scale of the crisis and the required response.

It is not difficult to conduct a survey, but there are a number of critical points that have to be correct for the results to be valid. It does require planning, training, supervision of staff, interaction with the community, and at least a basic understanding of the concepts of epidemiology and statistics.

A survey should provide information that is accurate and reflects the current situation—not the situation at some time in the past. It should be relatively simple to conduct. The results should be available in time for the data to be useful for the intervention. Complex surveys that attempt to answer many questions and give a complete picture are difficult to conduct, analyze, and interpret. They also cost a lot and require special expertise. The information is often outdated by the time the survey is finished, and it is not easily

[3] Collecting and analyzing data for advocacy, policymaking, and other such purposes is also necessary; methods for collecting data for these purposes may be different from the methods advocated in this manual. Because this manual is designed for use by field staff without special epidemiological knowledge or experience, it is limited to the methods that yield reliable information for programming.

repeated to give an ongoing picture of changes. It is nearly always better to do a relatively simple survey that answers only the pressing, critical questions, and that can be repeated as the situation evolves. Each additional piece of data gathered, even if it is relatively simple itself, degrades the quality and care with which the critical data are gathered and delays the survey.

This manual is designed to be used in conjunction with the accompanying software, Nutrisurvey for SMART, which is freely available from www.nutrisurvey.de/ena/ena.html.

3 The steps in undertaking a survey

The steps we are going to consider for mortality, nutrition, and food security surveys are as follows:

- deciding whether to do a survey
- defining the objectives
- defining the geographic area and population group(s) to be surveyed
- meeting the community leaders and local authorities
- determining when the assessment is to be undertaken
- selecting the sampling method and clusters
- gathering available information
- deciding what additional information to collect
- obtaining and preparing equipment, supplies, and survey materials
- selecting the survey teams
- training survey team members
- managing the survey
- enhancing the accuracy of data collected
- writing the report and presenting it to interested parties

This section of the manual describes those steps that are common to all the components of the survey. Steps that differ for the different components are summarized and explained in other sections.

3.1 Deciding whether to do a survey

The decision to undertake an assessment is usually made in conjunction with the government, partner agencies, and donors. To prevent unnecessary repetition or overlap by different agencies, it is always important to share information about when and where you plan to undertake a survey. Surveys are usually much more informative if they are coordinated so that data from several agencies, geographic areas, or population groups can be examined together to give a wider perspective on the situation.

Conducting an assessment is expensive and time-consuming, so before starting you should consider the following points:

- Are the results crucial for decisionmaking? If a population's needs are obvious, immediate program implementation takes priority over doing a survey, and the survey should be deferred. For example, after a natural disaster, such as a flood, where it is clear that the population's food stocks have been destroyed, the current nutritional status may reflect the pre-disaster state. In dramatically changing situations, nutritional and mortality surveys are not helpful guides to current or future needs. If large numbers of malnourished children are present at a center, implementation of relief programs should not be delayed until a survey is conducted. The Sphere minimum standards require that a nutrition assessment be conducted when a targeted feeding program is implemented (The Sphere Project 2004); however, this does not mean the program should be delayed until after the survey is completed if the need is clear. Where such programs exist, periodic surveys should be conducted. If another agency has recently carried out a nutrition assessment in the same area, that data should be used rather than repeating the survey.

- It should be anticipated that the results will lead to action: there is little point of doing a survey if you know a response will not be possible. If the agency cannot itself implement a program where needed, the results must be useful in advocating for a response.
- Is the affected population accessible? Insecurity or geographical constraints may result in limited access to the population of interest. If this is extreme, a survey cannot be conducted.

3.2 Defining objectives

Clear objectives make it much easier for your team, the population, and donors to understand why the survey is being conducted. This should be clearly stated at the outset.

Emergency nutrition assessments are usually conducted to assess the *severity* of the situation by quantifying the acute malnutrition and mortality in a given population at a defined point in time. This is done by estimating the prevalence of wasting and edema in children aged 6–59 months and the death rate of the entire population. With an estimate of population size, the proportions of malnourished and the death rate give an estimate of the absolute number of malnourished in the community and how many have died in the recent past. These figures indicate the *magnitude* of the problem. The estimates, together with previous surveys, food security and contextual data, also indicate the *urgency* of the situation and how it may evolve in the future.

Where the survey is undertaken during a stable period, the data can be used to establish a baseline from which future changes can be monitored over time.

Undertaking a nutrition and mortality survey provides an opportunity to collect additional information that can be critical in deciding which interventions are most important. Immunization and nutrition program coverage, vitamin A, iodine, anemia, or other micronutrient deficiency, disease morbidity, trauma experience, cause of death, demographic, migration, and many other variables can all be important.

It is critical to understand that each additional piece of data collected degrades the accuracy of the whole dataset and prolongs and complicates the survey. Thus, any additional information to be collected should be clearly stated and justified in the objectives and have a realistic prospect of leading to a meaningful intervention.

Nevertheless, such data are usually needed. Consideration has to be given to whether the information could be collected more efficiently in other ways (for example from health clinics, sentinel sites or a surveillance system), or whether it would be better to conduct a separate survey to collect the supplementary information. If additional information is to be included in the survey it must be quickly and reliably obtainable during a short visit to the household.

3.3 Defining the geographic area and population group to be surveyed

3.3.1 Geographic area

In designing the survey, the area and population to be surveyed should be carefully defined. The report should contain a map of the area. Many agencies do a survey confined to the area in which they intend to implement a program. They have normally chosen this area because it is thought to be most needy. This decision is usually made after a rapid assessment; interviews with key informants, migrants, and refugees; by determining the origin and history of severely malnourished patients attending clinics or hospitals; and by looking for indications of increased mortality in the population. These data are used to justify the survey. The survey is often the last step before implementation and is used to persuade donors of the severity and urgency of the situation in a particular area. Data from such a survey *cannot* be extrapolated to indicate the severity of problems in other areas, because the area has been chosen on the basis of an expectation that it is particularly affected.

In many cases, the area chosen will correspond to one or more administrative areas (for example, a district). The survey should be conducted in an area where the population is expected to have a similar nutritional and mortality situation. If an area is assessed that has two or more very different agro-ecological zones, the results will be an average of the two zones and not give an appropriate perspective of either zone. Such heterogeneity can be resolved by doing separate assessments, although this usually increases the cost.[4] In general, urban and rural areas, refugee/IDP, and resident populations should be assessed separately.

Frequently, there are areas that cannot be accessed because of insecurity. These areas need to be defined before the survey, clearly marked upon the map, and reported as having been excluded from the survey. Populations living in highly insecure areas normally have a worse nutritional status and higher mortality than those living in more secure areas; nevertheless, it is unlikely that a program can be implemented successfully in areas that cannot be surveyed.

Measurements can be made on new arrivals from insecure areas. Although such data give a valuable indication of the situation in the insecure area, they do not constitute a survey and should not be reported as such. Arrivals are often better off than those who have not been able to migrate from an area of insecurity. However, this should not be assumed: they may have left the area because (unlike those remaining) they are unable to sustain

[4] However, it may not increase the cost appreciably, because a much larger sample size is needed where there is heterogeneity. Sometimes two separate surveys can be conducted in two areas, each of which is homogeneous, with the same overall number of subjects from one large survey from a heterogeneous population. This is addressed in the section of the manual dealing with "design effects."

themselves or have been rejected by the rest of the population. Often, relief programs have to take account of such migration from insecure areas that have not been, and cannot be, surveyed.

3.3.2 Population groups

Anthropometric measurements and edema assessments are most commonly made among children ages 6–59 months, and a crude death rate (CDR) is assessed for the entire population (*all* deaths within a defined period of time). The 6–59-month-old child is considered the most sensitive to acute nutritional stress. This age group is chosen, therefore, to give an indication of the severity of the situation in the *whole population.* Furthermore, there are often baseline data for this age group, considerable experience in conducting surveys of its nutritional status, and defined criteria for interpretation. However, in some situations it may be appropriate to include other age groups, such as less than 6-month-old infants, adolescents, adults, or the elderly if it is suspected that their nutritional status differs significantly from that of the 6–59-month-old child. Although other age groups do not need to be surveyed, it is crucial to emphasize that limiting the survey to the 6–59-month age group cannot be used to justify confining interventions to this age group. If a survey has to be made for each age group before it receives help, the surveys themselves would become extremely cumbersome. Every malnourished individual should be eligible for relief.

3.4 Meeting community leaders and local authorities

It is absolutely essential to meet the community leaders and local authorities before starting a survey. The meetings should at least cover the following points:

- Agree with the community about the objectives of the survey. If the population does not understand why you are doing an assessment they may not cooperate during the survey.
- Obtain a map of the area to plan the survey. Use this map during the discussions with the local authorities and community leaders.
- Obtain detailed information on population figures (particularly at the village or camp level).
- Obtain information on security and access to the prospective survey area.
- Obtain letters of permission from the local authorities (in the local language), addressed to the district or village leaders, stating that you will be visiting. The letters should explain why you are conducting an assessment and ask for the population's cooperation.
- Agree upon the dates of the survey with the community and local authorities.
- Agree how the results will be used. In particular, realistically discuss the prospects for intervention, steps that will be taken, and types of programs that are likely to be implemented if the situation is found to be as poor as expected. Do not make promises that may not be fulfilled.

3.5 Determining the timing of the assessment

The exact dates of the assessment should be chosen with the help of community leaders and local authorities to avoid market days, local celebrations, food distribution days, vaccination campaigns, or other times when people are likely to be away from home. Roads may be impassable during the rainy season. In agricultural areas, women may be in the fields for most of the day during ground preparation, planting, or harvesting. Healthy children are more likely to accompany adults to the market or the fields and are less likely to be in the home than ill or malnourished children. The survey results could be wrong if only children who were at home at the time of the survey team's visit are sampled. Wherever possible, community leaders should inform the villages chosen to be surveyed in advance.

There needs to be sufficient time allocated for preparation and literature review, training, pilot testing, community mobilization, data collection, analysis, and reporting.

3.6 Selecting sampling methods for the nutritional and mortality components

The basic principle for selecting the households that will be visited is that every child in the whole study population should have an equal chance of being selected for the nutritional survey, and every person for the mortality survey. If, at any stage, the recommended method has to be changed for practical reasons, then those in charge have to consider whether every household and child is equally likely to be sampled.

The three commonly used methods are simple random sampling, systematic random sampling and cluster sampling.

3.7 Gathering available information

Before starting the survey, it is important to learn as much about the population as possible from existing sources, including population characteristics and figures, previous surveys and assessments, health statistics, food security information, situation reports (security and political situation), maps, and anthropological, ethnic, and linguistic information. Only after these data are gathered can judgment be made about any additional information that should be collected.

3.8 Deciding what additional information to collect

The data collected must correspond to the assessment's objectives.

The mortality and nutritional data are gathered at the same time from the same households. Food security data are not collected from households, but through key-informant interviews with people or groups from the same community.

3.8.1 Children's nutritional data

To estimate the prevalence of acute malnutrition in children aged 6–59 months, the following data should always be collected:

1. age, in months (from a known date of birth or based on an estimate derived from a calendar of local events)
2. sex
3. weight in kilograms (to the nearest 100 g)
4. height, in centimeters (to the nearest millimeter)
5. presence or absence of edema

3.8.2 Other child data that are often collected (depending upon specific survey objectives)

6. mid-upper arm circumference (MUAC)
7. measles immunization (and possibly BCG) status
8. micronutrient supplementation status, particularly vitamin A
9. nutrition program coverage
10. morbidity information

3.8.3 Mortality data

To estimate the mortality rate, the following information needs to be collected:

1. total number (of all ages) currently in the household
2. number who were in the household at the start of the recall period
3. number of deaths
4. number of births
5. number who left the household during the recall period
6. number who joined the household during the recall period

3.8.4 Other household data that are often collected

7. age and sex of each household member
8. number of deaths of children below age 5
9. information about cause of death

3.8.5 Food security

Food security data are collected at the same time from the same population, but by separate teams using different methods. Food security and other questions are not added to the nutrition/mortality survey. Food security data comes mainly from key informant interviews using the household economy approach, market assessments and observations. The training and skills required to collect these data are different from those required for nutritional and mortality assessment (see section 4).

3.9 Obtaining and preparing equipment, supplies, and survey materials

Measuring material, scales, and height boards should be in good condition. During the survey, scales should be checked each day against a known weight (standard weight). If the measure cannot be made to match the weight by adjustment of the zero and span controls, the equipment should not be used. Spare equipment is needed to allow for damage or loss.

Equipment and supplies needed for the survey include transport, fuel, paper and pens, per diem, and recording forms.

Copies of questionnaires, absentee forms and forms for referral of moderately or severely malnourished cases to supplementary feeding and therapeutic feeding programs (if they exist) should be prepared.

3.10 Selecting the survey teams

3.10.1 Nutrition and mortality survey teams

For the nutrition and mortality components, each survey team has a minimum of three people. Two make the anthropometric measurements, while one records data and serves as the team leader. The team leader is responsible for the quality and reliability of the data collected. The same team members can sometimes take both the anthropometry and conduct the mortality interview. However, it is usually better to have a fourth team member who interviews the head of household to collect the census and mortality data.

To make implementation more efficient and rapid, a respected member of the community should be asked to participate with each team. He/she will know the village and be able to guide the team, locating households. The community member can more easily learn the whereabouts of absent households, and perform the often vital function of translation. If for some reason the community member does not speak the local dialect, it may be necessary to include a translator on the team.

Team members do not have to be health professionals. In fact, anyone from the community can be selected and trained. They need to be fit, as there is usually a lot of walking. They should have a relatively high level of education, as they will need to read and write fluently, count accurately. Ideally, they will speak the local language. Women generally have much more experience dealing with young children and should usually make up the majority of the team. In some cultures, it is necessary to have at least one male member of the team to interview male heads of household. Most importantly, team members should be friendly, eager to learn, and hardworking.

Two to six teams may be needed depending upon the number of households to be visited, the time allocated to complete the survey, and the size and the accessibility of the area covered. Although it is faster to have more teams, the quality of the data deteriorates. It is also much more difficult to train, supervise, provide transport and equipment, and organize a large number of teams. All team members and their equipment should be able to fit comfortably in the available transport.

A survey supervisor, experienced in undertaking nutrition and mortality surveys, training team members, organizing logistics, and managing people, should also be arranged.

3.10.2 Food security survey team

There is an entirely different team for the food security component of the survey. One team is sufficient, and this team will be trained separately from the nutrition/mortality survey team. They will not be selecting houses at random. Food security data are semi-quantitative, and data reliability is assessed through replication of interviews among the various informers/groups.

3.11 Training survey team members

Adequate training of the survey team members before the survey is critical. All scheduled training must be completed prior to data collection, and every team member should undergo exactly the same training, whatever their former experience, to ensure standardization of methods. During the survey the supervisor must continually reinforce good practice, identify and correct errors, and prevent declining measurement standards.

3.12 Managing the survey

The supervisor/team leader has the overall responsibility for training team members, visiting teams in the field, ensuring that households are selected properly, and ensuring the equipment is checked and calibrated each morning during the survey and that measurements are taken and recorded accurately. Unexpected problems nearly always arise during a survey, and the supervisor is responsible for deciding how to overcome them. Each problem encountered and decision made must be promptly recorded and included in the final report. The survey supervisor is also responsible for overseeing data entry and for the analysis and report writing.

Where possible, the survey supervisor should organize an evening wrap-up session with all the teams together to discuss any problems that have arisen during the day.[5]

[5] This may not be impossible if the survey area is large and teams are widely separated or remain in the field for several days. Communication with teams in the field is often very difficult. In such circumstances, team leaders must be sufficiently trained to make decisions independently.

Before leaving the field, each team leader should review and sign all forms to ensure that no pieces of data have been left out. If there were people absent from the house during the day, the team should return to the household at least once before leaving the area.

It is also the duty of the survey supervisor to regularly supervise teams in the field. It is particularly important to check cases of edema, as there are often no cases seen during the training and some team members may therefore be prone to mistaking a fat child for one with edema (particularly with younger children). The supervisor should note teams that report a lot of edema, confirm measles and death cases, and visit some of these children to verify their status.

It is very important not to overwork survey teams. There is a lot of walking involved in carrying out a survey, and when people are tired, they may make mistakes or fail to include more distant houses selected for the survey. The supervisor must make sure the team has enough time to take appropriate rest periods and that it has refreshments.

3.13 Enhancing the accuracy of the data collected

Each evening, or during the next day while the teams are in the field, the supervisor should arrange for data to be entered into the computer. Recording errors, unlikely results, and other problems with the data may become clear at this stage. The Nutrisurvey software will automatically flag abnormal values as data are entered. Each morning, before the teams set out for the day, there should be a short feedback session. If any team is getting a large number of "flagged" results, the supervisor should accompany that team the next day. If the results are very different from those obtained by the other teams, it may be necessary to repeat the cluster from the day before.

Team leaders and survey supervisor should record all important points in a notebook as soon as possible (e.g., during breaks or at base in the evening), including observations, ideas, problems, actions taken to address these problems, and the reasoning behind any decisions taken. Each note should be labeled with the date, location, and names of relevant people.

Apart from the evening and morning meetings, survey team members should be encouraged to regularly discuss their experiences and findings together. This often brings out important points, and sometimes shows where survey methods need to be modified.

If possible, at each household the team leader should calculate or look up in a table the percentage weight-for-height (WFH) median score for each child and classify the child's nutrition status. This should certainly be done for any child who appears to be malnourished. When a malnourished child is identified he or she should be referred, on the spot, to the nearest health or nutrition facility. Ideally, this will be a therapeutic or supplementary feeding program. If these are not available, the supervisor should urge the parents to take the child to the nearest health facility, providing a referral slip upon which the name, height, weight, percentage WFH, and diagnosis is written.

The team collecting the food security data should also attend the evening wrap-up meetings. From their experiences conducting interviews, they will often be able to contribute valuable anthropological insight into the problems encountered by the other survey teams. They will also benefit from meeting a variety of the teams working in different villages in the area, enabling them to assess how representative the villages selected for key informant interviews are of the entire area, and if such interviews should be replicated elsewhere.

3.14 Writing and disseminating the report

The final part of a survey is writing and disseminating the report. The results of the survey should be presented in a standard format so that different surveys can be compared, and no important information should be left out. After being introduced to the standard format, it is also becomes much easier for readers to find particular pieces of information in the report.

The Nutrisurvey software has been designed to automatically present all important data in standard format under standard section headings. The results of an emergency survey must be released and disseminated as soon as possible to prevent any delay in the intervention. Reports for emergency nutrition and mortality surveys should be available no later than one week after completing data collection. Baseline survey reports may not be needed so soon.

The report melds data from the nutrition and mortality components with the food security data to give an overall picture of the situation within the survey area. The quantitative data on anthropometry and crude death rates require context, and the report is designed to provide this, partially through a discussion of background information and previous surveys, but mainly through the presentation of the food security data gathered from the same area during same time period. All together, the report is intended to be used to make recommendations and formulate plans of action for intervention.

4 Nutrition and mortality survey

4.1 The nutrition component

4.1.1 Why do a nutrition survey?

Whether due to starvation, loss of appetite, malabsorption, or psychological causes, children who have not taken a sufficient amount of food do not grow; and under more severe circumstances, they lose weight. Decreased growth rate is assessed by comparing the ratio of a child's height to weight to a reference standard for the child's age. For an individual, these measurements are used to decide whether the person is admitted to a supplementary feeding program or treated for severe malnutrition. At the population level, the same measurements are used in the survey to estimate what proportion of a population as a whole is moderately or severely malnourished.

Malnutrition in the context of this manual takes three forms: 1) failure to grow results in height *stunting*; 2) loss of body tissue results in *wasting*, and 3) accumulation of fluid results in nutritional edema (also called *kwashiorkor*, or hunger edema). The prevalence of each of these is assessed during a nutrition survey by recording age, measuring weight and height, and examining for edema.

Other forms of malnutrition, such as micronutrient deficiency, are not usually assessed during a nutrition/mortality survey, even though they may be very important causes of morbidity and mortality. Most micronutrient deficiency diseases do not cause stunting or wasting, and their prevalence cannot be determined from anthropometric measurements.[6]

4.1.2 Populations for anthropometric surveys: 6–59-month-old children

In emergencies, wasting among children aged 6–59 months is used as a proxy indicator for the general health and wellbeing of the entire community. This assumes that children aged 6–59 months are the most vulnerable group in the society, at least as vulnerable as each of the other age groups. This is usually, but not always, true.

In practice, this group is much easier to measure than other population groups. Young children are generally at home, the parents are usually concerned about their children and willing for them to be measured, and they are not embarrassed by (nor are there as many cultural restrictions about) taking off their clothes. Also, the equipment needed is not as cumbersome as that for older age groups.

There are a few other very basic reasons why children aged 6–59 months are a good group to survey. First of all, policymakers are used to seeing and acting upon this type of data. There is a lot of experience with surveys of this age group, affording those using the data to make decisions the opportunity to compare the new survey with previous surveys. Furthermore, there is not yet international agreement on the anthropometric indicators and cutoff points used to assess acute malnutrition in adolescents, adults, pregnant and lactating mothers, and older people.

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[6] An important corollary of this is that if the result of the anthropometric survey does not give rise to concern, there could still be major undetected micronutrient deficiency in the population that is an underlying cause of illness and death.

It must be reiterated that surveys of children aged 6–59 months are used to indicate the situation of the whole population and not just young children, and restricting data collection to this group should in no way be understood as justification for confining relief to them.

4.1.3 When to measure the nutritional status of people over age 5

Surveys including other age groups are more complex and require greater technical expertise than for children aged 6–59 months. However, it may be appropriate to assess the nutritional status of other age groups in the following circumstances:

1. When there is a relative increase in the crude death rate (CDR) compared to zero to 5 death rates. The 0–5 death rate is generally about twice the CDR. A disproportionate increase in the CDR suggests that there is a particular problem in older age groups so that the 6–59-month age group is no longer a good indicator of the stress of the whole population.
2. When there is reasonable doubt that the nutrition status of young children reflects the whole population's nutritional situation. For example, in populations where cultural traditions give preference to the feeding of young children, or when there is a high prevalence of HIV, older adults may be more severely affected.
3. When many adults or older children present themselves to selective feeding programs or health facilities with malnutrition.
4. When credible anecdotal reports of frequent adult or adolescent malnutrition are received.
5. When the data are required as an advocacy tool to persuade policymakers to address the needs of other age groups. Ideally, this should not be necessary.

The methods for sampling and measuring other age groups are the same as those for the 6–59-month age group described in this manual. Infants less than 6 months can be included in the survey, but there are particular difficulties related to the accuracy and precision of the measurements.

4.1.4 Nutrition indices and indicators

To determine the nutrition status of an individual, the weight, height, age, and presence of edema are recorded. The relationship of these measurements to each other is compared to international reference standards. The nutrition surveys are designed with respect to three indices: height-for-age (HFA), weight-for-height (WFH), and weight-for-age (WFA).

Growing children get taller, and the height of a child in relation to a "standard" child of the same age gives an indication of whether the growth has been normal or not. This index of growth is called *height-for-age.* Children who have a low HFA are referred to as stunted. Growth is a relatively slow process, and if a child of normal height stops growing it takes a long time for that child to fall below the cutoff point for stunting.[7] For this reason, HFA is often used to indicate long-standing or chronic malnutrition. If the

[7] A child who is 100% of normal growth who falters to 70% of normal will take up to half his life to fall below the usual cutoff point and be labeled as moderately stunted. Thus, a 1-year-old child who is gaining height at 70% of normal will not be designated as stunted for six months.

insult that led to stunting is in the past, it is possible that the current growth rate is actually normal (although this is unusual without a change in the family circumstances). Stunting may also be due to intrauterine growth retardation followed by normal postnatal growth.

A child getting taller will also gain weight if body proportions remain normal. A thin child will weigh less than a normal child of the same height. *Weight-for-height* is a measure of how thin (or fat) the child is. Because weight gain or loss is much more responsive to the present situation, WFH is usually taken to reflect recent nutritional conditions. Being excessively thin is called wasting. It is also often termed "acute malnutrition," although individual children may have been thin for a long time. An advantage of using WFH to assess the nutritional state is that it does not involve age; in many poor populations, age is not known and is difficult to estimate reliably, especially in emergency situations.

Neither stunted nor wasted children weigh as much as normal children of the same age. *Weight-for-age* is thus a composite index, which reflects both wasting and stunting, or any combination of both. In practice about 80% of the variation in WFA is related to stunting and about 20% to wasting. It is *not* a good indication of recent nutritional stress. It is used because it is an easy measurement to take in practice, and can be used to follow individual children longitudinally in the community.

Mid-upper arm circumference (MUAC) is also sometimes measured. It directly assesses the amount of soft tissue in the arm and is another measure of thinness (or fatness), like WFH. Although it is easier to measure MUAC than WFH, it is more difficult to make a precise measurement, it is not standardized for age, and the cutoff points are not universally accepted. Nevertheless, MUAC is the best index to use in the community (for screening) to identify individual children in need of referral for further assessment or treatment. Because MUAC is used in this way in the community, it is useful to know the relationship between WFH and MUAC in a particular community to establish a full nutrition program including screening. This is why MUAC is sometimes included in the data collected in a survey. MUAC data are often not reported or emphasized in a report, and decisions are not usually based upon these data alone.

WFH, HFA, and WFA are calculated for individuals and groups using the Nutrisurvey software.[8] Users of this manual are not expected to have to calculate these values without the aid of a computer.

4.1.5 The reference population curves

To assess malnutrition as determined by WFH, WFA, and HFA, individual measurements are compared to an international reference standard. At present that standard is derived from surveys undertaken in the United States (NCHS/WHO/CDC reference table, WHO 1983). New reference values are currently being compiled, and SMART will adopt these new standards whenever they become available. However, until many surveys have been conducted with the new standards and the humanitarian community has become used to interpreting the results, SMART will continue to report the prevalence of malnutrition using existing and new standards.

[8] The software "Epiinfo" can also be used to calculate the nutritional variables.

The reference values should not be considered "ideal"; they are simply used as a standard to compare nutritional status in different regions, and in populations over time. It is a standard in the same way that the meter or the kilogram are standards used to measure length or weight.

Each team should have a copy of the reference standards tables so that during the survey they can identify children who need immediate referral to a nutrition or health facility.

4.1.6 Expression of nutrition indices

Anthropometric indices are usually expressed in two ways: as the percentage of the median value of the reference standard, or as z-scores derived from the reference standard.

4.1.6.1 The percentage of the median

The percentage of the median[9] WFH (often written WHM[10]), compares the weight of the child to the median weight of children of the same height in the reference population (see box 1). The calculation of WHM for each child is based on the child's weight and the median weight for children of the same height (and sex) in the reference population:
WHM = the child's weight divided by the reference median weight × 100

Box 1. Example WHM calculation
In a nutritional survey, a male child 92cm tall weighs 12.1kg. The median weight for boys in the reference population who are 92cm tall is 13.7kg. **WHM = 12.1/13.7 × 100 = 88.3%**

4.1.6.2 The z-score

A z-score is another measure of how far a child is from the median WFH of the reference (often written WHZ). In the reference population, all children of the same height are distributed about the median weight, some heavier and some lighter. For each height group, there is a standard deviation among the children of the reference population. This standard deviation is expressed as a certain number of kilograms at each height. The z-score of a child being measured is the number of standard deviations (of the reference population) the child is away from the median weight of the reference population at that age group. This is illustrated in figure 1 below:

[9] The median is a type of average. It is used instead of the mean because the standard population is not normally distributed. This was a problem with bottle feeding making some of these children obese so that the upper half of the distribution is slightly more "spread out" than the lower half. The median is simply the middle value that has half the population above and half below a given value.
[10] It is also sometimes written as "WHP." However, this abbreviation is also used for WFH expressed as a centile value, because of common misuse of "percentile" in place of centile. The abbreviation has been changed to WHM to avoid confusion.

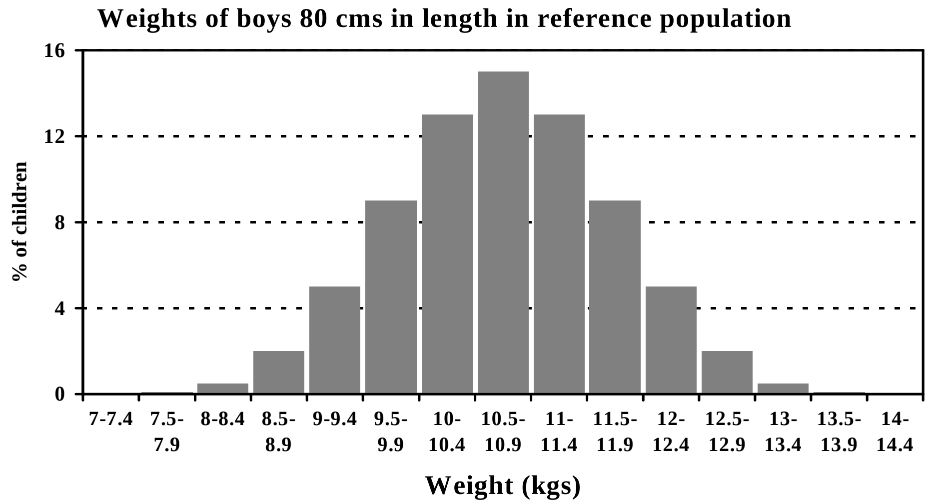

Figure 1. Reference curve used to derive a z-score

The WHZ is based upon the child's weight, the median weight of children of the same height and sex in the reference population, and the standard deviation of the distribution of weights in the reference population for children of the same height and sex.

WHZ = (child's weight minus reference median weight) divided by the standard deviation of weight for the reference population.

These calculations should all be done by computer using the Nutrisurvey software, but it is useful to understand the basis for the calculation (see box 2).

Box 2. Example z-score calculation

In a nutrition survey, a male child of 84 cm weighs 9.9kg. The reference median weight for boys of height 84 cm is 11.7kg. The standard deviation from the reference distribution for boys of height 84 cm is 0.908 kg. The z-score for this child is then as follows:

4.1.7 Definitions of acute malnutrition in children aged 6–59 months

WFH is the criterion used to assess moderate and severe wasting, monitor changes in the nutrition status of the population, and make decisions on admission and discharge of individuals to and from feeding programs.

4.1.7.1 Edema

The presence of edema should also be assessed during the survey. Pitting edema on both feet (bilateral edema) is the sign of kwashiorkor. In an emergency context, any person with bilateral edema has severe malnutrition[11] and is classified as severely malnourished even if the WFH z-score or percent of median is normal.

4.1.7.2 Moderate, severe, and global malnutrition

Individuals are classified as normal if they have no edema and have a WFH equal to or above –2 Z-scores (or 80% of the median). If they are less than –2 z-scores (or below 80% of the median) and equal to or above –3 z-scores (or 70% of the median), they have moderate-acute wasting. If they are below –3 z-scores (or 70% of the median), or if they have edema on both feet, they have severe-acute malnutrition, which is sometimes referred to as SAM.[12]

Table 1. Definitions of acute malnutrition using WFH and/or edema in children aged 6–59 months

Acute malnutrition using WFH	Percentage of median	Z-scores	Edema
Severe	< 70%	< –3 z-scores	Yes/no
	> 70%	> –3 z-scores	Yes
Moderate	< 80% to ≥ 70%	< –2 z-scores to ≥ –3 z-scores	No
Global	< 80%	< –2 z-scores	Yes/no

Global acute malnutrition (GAM) is the term used to include all children with moderate wasting, severe wasting or edema, or any combination of these conditions.

In the examples above, the child with a WHM of 88.3% is not acutely wasted (malnourished), because his WHM falls above the cutoff point for acute malnutrition. The child who had a z-score of –1.98 is also above the cutoff point and is not classified as acutely wasted (malnourished) (see boxes 3 and 4).

The user of this manual will not have to make these calculations: they are done automatically using the Nutrisurvey software. GAM and SAM should be presented as prevalences expressed as a percentage of the population. Two values are presented: one is the GAM and SAM derived from the z-score calculations, the other is derived from the percent of the median calculations.

[11] There are other causes of bilateral edema such as heart failure, kidney disease (nephrotic syndrome), thiamine deficiency, and pre-eclampsia in pregnant women. However, in an emergency context, most bilateral edema, especially in children, is due to kwashiorkor.

[12] Note that the terms “severe wasting” and “severe acute malnutrition” are not synonyms. A child with severe acute malnutrition is either severely wasted, edematous, or both. Severe acute malnutrition is the sum of severe wasting and edema.

Box 3. Example SAM and GAM calculations
A group of 905 children was measured in a survey. None of the children had edema. Fifteen children had WHZ< –3 z-scores and 45 had WHZ< –2zscores and ≥ –3 z-scores.

Prevalence of severe acute malnutrition (SAM) = number of severely malnourished children divided by total number of children multiplied by 100 = (15)/905 × 100 = 1.7%

Prevalence of moderate acute malnutrition = number of moderately malnourished children divided by the total number of children multiplied by 100 = (45)/905 × 100 = 5.0%

Prevalence of global acute malnutrition (GAM) = prevalence of severe acute malnutrition plus the prevalence of moderate acute malnutrition = 1.7 + 5.0 = 6.7%

Box 4. SAM/GAM scenario
Another group of 910 children was measured in a survey. Six had edema, and of these six, one had a WFH z-score < –3.0, two had WFH z-scores between –3.0 and –2.0, and three had WFH z-scores > –2.0. Overall, 17 children had WHZ < –3 z-scores, and 55 had WHZ < –2 z-scores and ≥ –3 z-scores.

Prevalence of severe acute malnutrition (SAM) = number of severely malnourished children divided by total number of children multiplied by 100 = (17 + 6 –1)/910 × 100 = 2.4%
One of the edematous children was also severely wasted. The child cannot be counted twice. The edematous are added to the severely wasted, and the number is reduced by the number of children who have both edema and severe wasting.

Prevalence of moderate acute malnutrition = number of moderately malnourished children divided by the total number of children multiplied by 100 = (55 – 2)/910 × 100 = 5.8%
Two of the moderately wasted children had edema: they have already been included in the severely malnourished category. The children cannot be counted in both categories. The moderately malnourished are the total with moderate wasting minus those moderately wasted children who had edema and were therefore counted with the severely malnourished.

Prevalence of global acute malnutrition(GAM) = prevalence of severe acute malnutrition

4.1.7.3 Why have both percentage of the median and z-scores to estimate acute malnutrition?

Z-scores and percentage of median produce slightly different estimates of the prevalence of wasting.[13] The z-score is said to be more statistically valid than the percentage of the median, and has become the standard index used in nutrition surveys. Nonetheless, there are several reasons why percentage of the median should also be reported.

[13] There will always be a higher prevalence of malnutrition using WHZ than WHM. The cutoff lines cross each other at the height of a normal 6-month-old child.

- It is a better predictor of mortality (the outcome of dominant interest) than z-score.
- It is used for the admission of patients to feeding programs, because it is a better predictor of death and directs resources where they are most efficiently used.[14] It is used for the admission of adolescents where WHZ cannot be used.
- It is easier for lay people to understand and for survey managers to explain because it does not require an understanding of statistical concepts.
- It is easier to calculate with a simple calculator.

Nutritional surveys should always report the prevalence of edema and of wasting (WFH) in terms of both z-score and percentage of the median in the body of the report, as well as the SAM and GAM.

4.1.7.4 Chronic malnutrition in children

The long time scale over which HFA changes makes it less useful for deciding when to intervene in an emergency. It is useful, however, for long-term planning and policy development. Although at an individual level stunting develops slowly, the degree of stunting can change within a few months when averaged over an entire population. Incorrect age data makes HFA information misleading, and reliable age data can be difficult and time-consuming to obtain. For this reason, age data are generally gathered in an emergency survey to determine if the child is appropriately included in the sample (i.e., is the child probably between 6 and 59 months?) or whether the sample is biased toward a particular age group, rather than to obtain accurate information about stunting.

4.2 The mortality component

4.2.1 Why do a mortality survey?

Usually, public health workers at the start of an emergency have to rely on cross-sectional surveys to determine current nutrition status and death rates in the recent past. Ideally, surveys complement a functioning surveillance system to estimate acute malnutrition, verify surveillance data, and answer specific questions the surveillance system is not providing answers for or about areas that the surveillance system is not covering.

An elevated death rate can indicate that there is a health problem in a population, but it cannot indicate the cause.

[14] The nutritional status of adolescents can also be expressed as WHM, but not as WHZ. Using WHZ for admission leads to many more admissions than WHM; the additional admissions generally do not need to be in therapeutic feeding programs.

4.2.2 Population for mortality surveys: all members living in the household for at least some part of the recall period

To determine the death rates, a member of each selected household is interviewed to obtain information on deaths and in-migration and out-migration of all household members present for at least some part of the recall period.

Data required are the number of people who live in the household and the number of deaths that have occurred during the recall period (a specified period of time in the recent past). Each day, each member of the household is at risk of death, although very few actually die on any given day. The actual deaths are expressed in relation to the number of people and the length of time they were at risk. We need to find out how many people have been at risk during the recall period—not just those in the house at the time of the survey. Therefore household members who have left the household should be counted. Similarly, those who have joined the household during the recall period have not been at risk for the whole of the recall period. During the calculations, these factors are taken into consideration.

4.2.3 Mortality measurements and indices

The *crude death rate* (CDR)[15] is defined as the number of people in the total population who die over a specified period of time. It is calculated using the following formula:

$$\textbf{CDR} = \frac{\text{Number of deaths}}{\left(\dfrac{\text{Total population}}{10,000}\right) \times \text{Time interval}} = \text{Deaths/10,000/day}$$

In the formula, total population is the population present at the midpoint of the time interval. The time interval is the length of time within which the respondents are asked to state if any deaths have occurred; this is usually referred to as the "recall period." The units for the formula are deaths per 10,000 per day when the "time interval" is expressed in days.[16]

[15] The term crude mortality rate (CMR) has been used when referring to deaths/10,000/day by some epidemiologists and those working in complex emergencies. Crude death rate (CDR) is usually used when referring to deaths/1,000/year (the units used by demographers and most epidemiologists). The terms are interchangeable. It is recommended that the term crude death rate be used. This is to maintain consistency with the expression of age-specific death rates, where there has been considerable confusion.

[16] The CDR can also be expressed using other units such as deaths/1,000/month, in which case the time interval is expressed in months and 1,000 is substituted for 10,000 in the formula. The conversion factor is 30.4/10 = 3.04 (there are an average of 30.4 days in one month) to convert a result expressed as deaths/10,000/day to deaths/1000/month multiply by 3.04. Similarly, to express the result as deaths/1,000/year, the time interval is expressed in years. The conversion factor is 365/10 = 36.5. to convert death/10,000/day to death/1,000/year multiply by 36.5. The different ways of expressing the CDR are *exactly equivalent*: one can be readily converted to another. In this manual and reports it is recommended that *all* death rates be expressed as deaths/10,000/day to avoid confusing nonexpert readers who become used to working with one set of units. This recommendation applies no matter the length of the recall period used.

4.2.4 Nomenclature: “age-specific death rate for children less than 5,” “under-5 mortality rate,” or “0–5 death rate”

There is an important problem with nomenclature that has led to considerable confusion. The term “under-5 mortality rate” is being used in two distinct and quite different ways.

First, demographers and epidemiologists use the term to denote the calculated probability of dying before age 5 expressed per 1,000 live births. In this original sense, it represents the probability of a child born during a particular year dying before that child reaches 5 years of age, assuming there is no change in the mortality rate. It is thus comparable to the infant mortality rate, which is the probability of a live born child dying before the age of 1 year. The calculations are quite complex, and it is also necessary to determine the birth rate. The under-5 mortality rate, used in this sense, cannot be calculated from the survey methods outlined in this manual. Therefore, the manual does not use the term “under-5 mortality rate,” except in very limited circumstances.

Second, those working in complex emergencies later used the same term to refer to the rate of death of children aged 0–5 over a specific time interval. It estimates the incidence of death over a recall period. In this sense it is comparable to the CDR. Epidemiologists and demographers also calculate this rate, but they refer to it as the “age-specific death rate for children 0–5” and use the notation “${}_5M_0$.” In a similar way, other age-specific death rates can be estimated for other age ranges of the population.

Although the same phenomenon is being estimated with both meanings of the term, the concepts, calculations, and numerical results are quite different. The numerical result using the first definition is (very roughly) five times higher than the second (although one cannot be calculated from the other).

In this manual we will restrict the term “under-5 mortality rate” to the first, original definition. We will use the term “0–5 year death rate” (0–5DR) for the second definition, denoting the age-specific death rate of children less than 5 years of age. This is simply a clarification of nomenclature introduced to avoid confusion. 0–5DR is the same as the under-5 mortality rate used in the past by those working in complex emergencies. To be consistent, we will also use the term “crude death rate” (CDR), rather than “crude mortality rate” (CMR), to denote the total death rate in the population over a given time interval.

4.2.5 Zero-to-five death rate

0–5DR is the number of children aged from birth to 5 years who die over a specified period of time in relation to the total number of children below 5 years of age in the population. It is calculated from the following formula:

$$\textbf{0–5DR} = \frac{\text{Number of deaths of children 0–5 years}}{\left(\frac{\text{Population of children 0–5}}{10{,}000}\right) \times \text{Time interval}} = \text{Deaths/10,000/day}$$

The formula is similar to that used to calculate CDR. In this case, only deaths in children from birth to 5 years are considered, and the population is the total number of children from zero to 5 years of age present at the midpoint of the time interval. The time interval is the length of time within which the respondents are asked to state if any deaths in children have occurred.

In general the 0–5DR, is about twice the CDR.

4.2.6 Determining the recall period

The *recall period* for the mortality survey is the *time interval over which you count deaths*. Deaths that occurred before the recall period are not recorded as deaths, even though the interviewer is often told about such deaths and will respond sympathetically.

If the recall period is three months, you will try to establish the number of deaths that occurred among your sample population during the three months prior to the day of the survey.

The number of deaths is expressed in relation to both the number of people sampled and the number of days they have been at risk. This "person-days" at risk is the denominator in the calculation of mortality rate. The length of the recall period is thus a critical factor in determining the mortality rate.

Six thousand people at risk over three months is mathematically equivalent, in terms of the total risk of death, to 3,000 people at risk over six months and 18,000 people at risk for one month. There must be a substantial number of person-days included to record sufficient deaths and determine the mortality rate with a narrow confidence interval. If the recall period is too short, a very large number of households will need to be visited and interviewed, which makes the survey unwieldy. On the other hand if the recall period is too long, the information on mortality rate may well be too out of date to be helpful in an emergency situation, particularly if the emergency is evolving rapidly. The following factors should be considered when you choose a recall period:

- Objectives: How will the mortality information be used? How current does the information have to be? What time period is needed to address the objectives?
- Are mortality rates changing rapidly? If so, knowing the mortality rate over the last few months is likely to be more important than knowing the rate over six months or one year.
- Seasonality: Does the mortality change markedly with the different seasons? If so then you are more likely to capture the current season if the recall period is not longer than a few months.
- Migration: Over a short recall period, there will be fewer household members leaving the household and fewer new members joining. This simplifies the interview and calculations. With mass displacement there may be very few households that have had a stable composition during a prolonged recall period.
- Accuracy: The shorter the recall period, the more accurate the estimate of mortality. This is because more distant events are more likely to be forgotten by respondents and there are likely to be more mistakes in the time of death. (Recall periods longer than one year should not be used.)

- Precision: The longer the recall period the more precise the estimate of mortality (the narrower the confidence interval) with a given sample size. This is because the "sample" is actually the number of person-days considered rather than simply the number of people. With a longer recall period, a smaller number of households needs to be interviewed to achieve an acceptable confidence interval.
- Logistics: The longer the recall period, the fewer persons (and households) needed in the sample. Although a longer recall period may increase the time needed at each household, the time saved by going to fewer households more than compensates for a longer interview.

If you want to increase precision, you may increase either the length of the recall period, the sample size (i.e., the number of households[17] in the survey), or both. Logistical constraints usually limit the number of households that can be visited by survey teams.

4.2.6.1 How to decide on the length of the recall period

- During an acute emergency, it is usually advisable to use approximately *a three month recall period*. A three month recall period is a compromise: it allows an estimate of the death rate that is generally close enough to the current situation to allow for planning health and nutrition interventions, while usually giving a reasonable level of precision from about the same number of households that will need to be visited for the nutrition component of the survey. A shorter recall period may result in insufficient precision; a longer recall period may not be sufficiently representative of the current situation and may increase recall bias.

- If the objective of the survey is to document mortality over a longer period of time, recall periods of up to 12 months are justified. For example, if major violence resulted in population displacement six months ago, you may want to document the mortality rate for two separate periods: three or six months before, and the six months since, the displacement. Because this increases the complexity of the mortality survey, it should only be included if the added information is useful and if the persons interviewed can reliably place deaths into the time intervals. Box 5 indicates the advantages and disadvantages of lengthening the recall period beyond three months.

[17] Household definitions are culturally specific and need to be decided and agreed before the survey. A frequently used definition is "who slept here last night and ate from the same cooking pot."

Box 5. Advantages and disadvantages of a longer recall period	
Advantages • Fewer households need to be interviewed to achieve the same precision. • If deaths are recorded for specific parts of the recall period, it is possible to look at subintervals of time (e.g., before and after major violence) or to examine seasonal trends.	*Disadvantages* • Mortality rate may be less relevant to current needs than a more recent mortality rate. • Important or traumatic events may be recalled as having occurred more recently than they actually did (recall bias). • Additional information, such as cause of death, becomes increasingly unreliable as the recall period lengthens.

The beginning of the recall period should *always* be a date that everyone in the population remembers, e.g., a major holiday or festival (Christmas, beginning of Ramadan, Duvali, etc.), an episode of catastrophic weather, an election, coup, political decree, or similar memorable event. Some populations are aware of the phases of the moon. Care should be taken for events that may have occurred at different times in the various parts of the survey area, such as onset of the rainy season or taking in the harvest. Very local events, such as a village feast, may be locally memorable, but there are likely to be some parts of the survey area that were unaware of that particular feast—their feast, with the same name, may have occurred at a different time.

You then calculate the length of the recall period by counting the days between this date and the date of survey data collection. This is very rarely a nice round number of days, like 90 days. The Nutrisurvey software allows you to enter any number of days for the recall period. In populations where calendar time is not closely followed, dates are not well remembered or there have been no memorable events, placing deaths in time can be very difficult. Such uncertainties should be fully documented in the report.

Box 6 takes you through an example of some of the things you will have to consider in selecting a recall period.

Box 6. Example of selecting a recall period

Imagine that you need to assess mortality in a rural population because it has been predicted that next year's harvest is going to be a failure and you want a baseline measurement now. The seasonal calendar of events that has a direct impact on mortality is shown below. The population faces seasonal shortages of food from May to October, but particularly from August to October. Outbreaks of malaria occur in the season of heavy rains in January and February. The harvest is normally due in November.

	Food shortage	Malaria outbreak
Jan		**X**
Feb		**X**
Mar		
Apr		
May	**X**	
Jun	**X**	
Jul	**X**	
Aug	**XX**	
Sep	**XX**	
Oct	**XX**	
Nov		
Dec		

Imagine you undertake the mortality assessment in October. If you use a recall period of three months, you will obtain mortality data that is affected by the worst of this year's food shortage period. If you use a recall period of six months, you will obtain mortality data that is affected by the moderate food shortage as well as the more severe food shortage. Other things being equal, your estimate of the CDR using the shorter recall period will probably give a higher CDR than the estimate using the longer recall period, because recent mortality has probably been higher than mortality in the more distant past. The same would be true if you were estimating the death rate for the malaria season during an assessment in March. If you took too long a recall period, you would dilute the effect of malaria on mortality rates. For a baseline, you may wish to select a recall period that covers the whole previous year to include all the seasonal influences on the mortality rate.

4.3 Planning the survey

4.3.1 Overview of sampling methods

The sampling method is selected based upon the way in which the households are distributed and the size of the population to be surveyed.

1. Occasionally, with very small populations, every household in the population can be visited (an exhaustive survey), but this is unusual.
2. Where the houses of the *whole population* of interest are arranged in a systematic way (such as in some refugee camps), simple or systematic random sampling is used for the entire sampling process.
3. Cluster sampling, the most common method, is used when households are distributed in an unstructured way that does not easily allow all households to be listed or numbered.

Normally, highly insecure areas are excluded from the population under consideration before selecting the clusters. Sometimes extra clusters are chosen so that if one or more cannot be visited because of sudden insecurity or refusal by leaders/elders of a given cluster for the members to be interviewed, the clusters can be replaced. Clusters that could not be visited cannot be considered part of the sampled population, and this must be reported and shown on the map.

4.3.1.1 Exhaustive surveys

If all the households from a given population were interviewed and all the children aged 6–59 months measured, we would get a precise picture of the nutrition status and mortality rate of the population. This is called an exhaustive survey, and it is possible in small populations such as a small camp or an institution such as an orphanage (box 7). For a larger population, an exhaustive survey is long, costly, difficult, and unnecessary. The results cannot be extrapolated to another camp or population. Exhaustive surveys will not be considered further in this manual.

Box 7. Example scenario for an exhaustive survey
An organization wants to know the rate of malnutrition in a small refugee camp for which it is responsible. There are between 2,000 and 3,000 people in the camp. It is estimated that 20% of the population is less than 5 years of age; therefore, there are about 400–600 children less than 5 years of age. In this case, all the children were measured and households interviewed in an exhaustive survey.

4.3.1.2 Representative sampling

Instead of interviewing all the households and measuring all the children, a sample may be taken to "represent" the whole population. It is important that the sample be chosen that indeed is representative of the whole population. This is done by choosing households at random. The critical point is that each household and child in the population must have an exactly equal chance[18] of being selected into the sample.

4.3.1.3 Convenience sampling is never used in a survey

Series of children measured in health centers, markets, or other places where people gather are not representative. Children that visit health centers are not the same as those that do not. Well children can go to the market, run around the village, and follow the assessment team, while sick children are more likely to be in the house. The results of measuring such groups should never be called a survey (it can be called a series), and no decisions should ever be based upon such a "grab" sample. Similarly, clusters can never be selected on the basis of convenience. If we were only to select households in villages that are near to the road, the survey would be biased. Villages near roads have better access to transport and may be wealthier than more remote villages. In each of these examples, all the households and children in the community do not have an equal chance of being selected. Merely going to a clinic, running around the village, or living near a road or in the center of a village should not make anyone more likely to be selected.

4.3.2 The relationship among precision, bias, and sample size

4.3.2.1 Precision and sampling error

Most surveys that estimate the prevalence of malnutrition or death rates randomly sample households selected from the population of concern. There will always be some differences between the results obtained from the sample, regardless of how big it is, and the entire population from which the sample was selected. For example, if a room contains 10 men and 10 women, random samples of 6 persons from this room will sometimes contain 3 men and 3 women, sometimes 4 men and 2 women, sometimes 2 men and 4 women, or, more uncommonly, 1 man and 5 women or 5 men and 1 woman; even more rarely would the sample have 6 men or 6 women. The frequency with which any of these samples are likely to be chosen can easily be calculated mathematically using standard statistical theory. The same principle applies to much larger samples from a population.

Samples that are very different from the entire population are much less likely to be randomly selected than samples that are similar to the entire population. The difference between the value derived from a sample and the true value in the entire population is called the sampling error.

The size of the sampling error of a survey can be estimated and is presented as confidence intervals.[19] If a survey were repeated many times with the same sample size and method, 95% of the calculated death or malnutrition prevalence rates would fall within the 95% confidence interval. The 95% confidence interval is thus an expression of how certain we are that the actual result in the population is similar to the result we have obtained from the survey. For example, if a survey estimates the prevalence of

[18] Or, if the chances are not exactly equal, the relative chances of being selected must be known beforehand. However, this makes subsequent calculations very complicated, so for practical purposes each child must have an equal chance of being selected.

[19] Other ways of expressing the sampling error, such as the standard error, are used in other contexts.

malnutrition to be 8.7% with a 95% confidence interval of 7.1%–9.5%, then we are 95% sure that the actual malnutrition prevalence in the population in which the survey was done lies between 7.1% and 9.5%.[20]

The confidence interval is an estimate of precision of the result, that is, how similar the results would be if the survey were repeated over and over. If the confidence interval is wide, sampling error may be responsible for a substantial difference between the estimate of the death rate calculated from the survey and the true value in the population. Precision is increased, and the confidence interval narrowed, with larger sample sizes. The larger the sample size, the narrower the confidence interval and, if there is no bias, the more certain we are that the survey result is close to the actual population value. For mortality surveys the sample is "person-days," and the sample size can be increased by either increasing the number of subjects or the recall period. Statistically, a large sample size is preferable. However, it takes more time, money, personnel, and other resources to measure more children or ask more households about mortality. During planning we decide the precision needed (how much uncertainty we will tolerate) and then calculate exactly how many children or households are needed in the survey to achieve this precision. Including additional children or households wastes resources, prolongs the survey, delays the report, and gives a result that is unnecessarily precise. The Nutrisurvey software calculates the sample size needed to achieve a given degree of sampling error in the results of the survey. This software should be used routinely to calculate the sample size instead of using the same sample size for all surveys. The factors entered into Nutrisurvey to calculate both nutrition and mortality sample size must always be included in the report.

4.3.2.2 Bias

Sampling error is not the only source of difference between a survey's result and the actual population value. Sampling error is due to the random selection of households from the population. It cannot be eliminated, but it can be minimized by selecting a larger sample. The degree of uncertainty is calculated by the software and presented in the report.

Bias is anything other than sampling error that causes the results of the survey to be different from the actual population prevalence or rate. Bias cannot be calculated nor its effect upon the result assessed. It is the main reason why surveys may not give an accurate answer. The fact that the results are biased is usually not appreciated by those doing the survey, it is usually not apparent from the results and its extent cannot be judged by those reading the reports.

Readers may distrust the results of a survey if the level of malnutrition or the death rates differ from those expected. The reader will examine a survey particularly closely if the results do not "triangulate." For example, if the food security and mortality data do not indicate there is a crisis when nutritional status is reported to be very poor, the reader will suspect the nutritional data is incorrect because of bias. This uncertainty can lead to relief being delayed or even denied by donors when it is urgently needed. Alternatively, it can

[20] The units used for precision (confidence interval) in this manual are the same as those used for the expressing the results. Thus, precision for GAM and SAM are expressed in as percentage of the population, and for CDR and 0–5DR as deaths/10,000/day.

lead to waste of supplies and resources if a relief operation is mounted when the situation is thought to be much worse than it actually is. The reader must be able to rely on the results of a survey, for there is a great deal at stake. A careful and full description of the methods and precautions taken to minimize bias is essential to give the reader sufficient confidence in the results to lead to action. If precautions to minimize bias are not taken, and fully described in the report, a skeptical reader will assume a mistake has been made and that the results can be discounted.

Bias is minimized by use of good technique. This is the main reason why the supervisor has to be experienced, adequate training is critical, and the report has to document all the steps taken to eliminate or minimize bias.

4.3.2.2.1 Examples of bias

1. Because the foot piece of a length-board was loose, one team systematically measured the height of each child 1 cm taller than he or she really was. Even though weight was accurately measured, each child’s WFH z-score was lower than it should, be and the prevalence of wasting was exaggerated. Any inaccuracy in the equipment or measurement technique will lead to systematic bias.

2. Inaccurately taken weight and height—even when the inaccuracy is random and evenly distributed between over- and under-measurement—results in systematic overestimation of the prevalence of wasting. This overestimate is greater for severe malnutrition than for moderate malnutrition, and relatively greater when the true prevalence is low than when it is high. The effect of inaccurate measurements is to widen the distribution curve. Because we are counting the number of children in the tails of the distribution below the cutoff point of –2 z-scores, any artificial widening of the distribution curve will increase the number of children in the tails and thus increase the apparent malnutrition rate. Analysis of many surveys has shown that this is a common and major cause of error. Its extent can be estimated from examination of the standard deviation of the WFH, which should always be 0.8–1.2 z-scores. If the SD is outside these limits, the prevalence of malnutrition should be calculated from the mean value assuming a normal distribution and an SD of 1 z-score unit (these calculations are performed by Nutrisurvey); this is the result that should be reported. The report should make it clear that the calculated prevalence is presented rather than the prevalence obtained from the count of children below the cutoff point, because of probable measurement errors.

3. Shortcuts are likely to be taken if the survey teams are required to work too hard, if there is inadequate time allocated to rest periods and refreshments, or if the time that can be spent in a particular household to administer the mortality questionnaire and measure the children properly is insufficient. Shortcuts can take many forms. The team members are usually aware that they have deviated from the standard method, but through solidarity will not inform the supervisor. A few common shortcuts should be watched for. First, a team may rush the interview or the measurements. Most teams try to complete at least one cluster each day, and they should be able to spend sufficient time in each house to complete their tasks properly within one day. Therefore, the data may be much more accurate if there

are 20, rather than 30, households in each cluster. Increasing the sample size may introduce substantial bias by provoking “shortcuts,” leading to an inaccurate result despite the effort to achieve higher precision. Secondly, a team may not select households at random when they reach a cluster site. They may go to the village and take a “convenience” sample because of tiredness, heat, hunger, or harassment, or because they have insufficient time to select the sample correctly. This tends to be more common in rough terrain or when there are long distances to walk.

4. Survey respondents sometimes misunderstand questions about mortality in their households and tell survey interviewers, for example, that persons who left the household are dead. This would lead to an overestimate of the death rate and increase the difference between the death rates calculated from the survey results and the actual population death rates.

5. The following are some of the sources of bias that occur particularly during the interview.

    a. *Recall error:* Respondents often fail to recall all deaths during a given recall period. Infant deaths, in particular those within a short time after birth, are particularly under-reported. Respondents may also misreport ages, dates, and salient events.

    b. *“Calendar” error:* Respondents may report events as happening within the recall period when they did not (or vice versa) due to lack of clarity about dates.

    c. *“Age heaping”/digit preference:* Respondents may round ages to a number ending in a 0 or 5. This is a particular problem with 0–5DR or other age-specific death rates.

    d. *Sensitivity/taboos about death:* In general, the death of a household member is not a subject discussed readily with strangers. In some cultures, taboos about death may hinder discussion if the subject is not broached with tact and understanding.

    e. *Deliberate misleading:* In some populations, with experience of relief operations, some respondents may deliberately give incorrect answers in the expectation of continuing or increased aid. This can be orchestrated by local people with authority.

    f. *Mistranslation:* Questionnaires may contain mistranslated key terms and concepts (a common example is what constitutes a family vs. household). Interpreters may misunderstand questions or mistranslate answers.

    g. *Interviewer error:* Enumerators may ask questions or write down answers incorrectly, skip questions, assume answers, or rush respondents in an effort to complete the interview quickly.

    h. *Data entry error:* In the process of data entry, answers can be miscoded or entered incorrectly.

i. *Analytic error:* In the manipulation of any data, especially quantitative data requiring statistical analysis, mathematical and conceptual errors can generate faulty results or explanations.

4.3.2.2.2 Detecting and minimizing bias

As bias cannot usually be calculated or corrected by the computer after data collection is finished, it is critical to avoid bias during sampling and data collection.

However, we can examine the quantitative data to see if there is likely to be some form of systematic bias. The teams should be aware that such techniques will be applied during the analysis to discourage their succumbing to the temptation to take shortcuts. The Nutrisurvey software automatically carries out four tests for systematic bias:

1. *A comparison of the data (WFH, edema prevalence, CDR and 0–5DR) collected by the different teams:* If any particular team has obtained data that is statistically different from the other teams, it is likely that this team's technique has created a systematic bias. The team differences are tested by a statistical technique called "analysis of variance" that is built into Nutrisurvey. The software will warn the analyst if any team's data are suspect. If this happens, and if there is time, the aberrant team's clusters should be resampled using a different team and the new data substituted for the aberrant data.[21] If resampling is not feasible within a reasonable time, the data should be analyzed with and without the aberrant clusters, and both results reported with a recommendation from the survey supervisor indicating which result is likely to be more reliable. There has to be a full report of such occurrences and how they are resolved (e.g., perhaps the team's equipment is faulty or their training has been inadequate).

2. *An examination of the distribution of WFH for each team separately:* If the standard deviation of WFH for any particular team is outside the range of 0.8–1.2 z-scores, their data should be replaced by the number of malnourished children calculated from the mean value for that team.

3. *An examination of the quantitative data for "digit preference":* As a result of rounding by the team member (or respondent), the data may contain an excessive number of reported height, weight, or age values ending in particular digits, typically 0 or 5. This is done overall and for each individual team. Such rounding by the measurer of the team usually results in an excess of 0 or 5 as the last digit. The data obtained during training should also be examined for evidence of digit preference.

[21] If the second team gets data that is similar to the original team's data, then there is probably a real difference between the particular clusters assigned to that team and the remainder of the clusters. If this is the case, the original data should be retained. The design effect will be unusually high. If the second team's data are very different from the original data this confirms there was a systematic bias in the work of the first team.

4. *A comparison of the data within clusters:* Teams tend to get tired during the day, and measurements are often taken more carefully in the morning than in the late afternoon. The data collected from the first and second half of each cluster is compared. If for example, there are 28 children in each cluster, and one cluster was done by each team each day, then all children with cluster numbers 1–14 are compared to those with cluster numbers 15–28. The final results for death rates, WFH, and edema cases are compared, as well as counts of household members, children, in- and out-migrants, and deaths and births.

These tests can indicate the presence of some types of systematic bias and help resolve the problem. Bias is particularly difficult to detect if all the teams have been trained to make the same mistake. Furthermore, bias is more likely to go unnoticed in the interview than with the quantitative measurements. It is far better to take great care to avoid bias and to demonstrate to the teams during training the disastrous effects of bias. There are a number of things that can be done to minimize bias:

- Carefully standardize measurement techniques.
- Use standard weights and length-sticks to check the accuracy of equipment.
- Train survey workers well.
- Write clear questions to be asked of survey respondents
- Back-translate all questionnaires.
- Use more than one translator and compare their results when interviewing the same households.
- Carefully choose the start of a recall period.
- Use local calendars.
- Use the minimum sample size that gives adequate results so that the teams are not stressed.
- Provide comfortable transport and clothing for the staff.
- Ensure adequate rest and refreshment periods.
- Make sure that the payment to the teams is agreed upon and adequate.
- Put together motivated, cohesive teams that participate fully in the daily meetings and report any difficulties promptly and faithfully. The teams must be trusted by the supervisor.
- Apply the standard techniques mentioned in this manual.

4.4 Sampling: An in-depth discussion

4.4.1 Sampling methods

There are three main sampling methods used for nutrition and mortality surveys: 1) simple random, 2) systematic random, and 3) cluster sampling. Each uses a standard method of selecting the subjects that is designed to eliminate bias and get a representative sample.

The first step in setting up a sampling scheme is to clearly define the population for which you need to estimate the prevalence of malnutrition. This might be the children living in a refugee camp, several villages, a district, a region, or even a whole country.

The second step is to obtain any available data on the population. This is critical, and the best place to obtain population data for a district is usually from district government offices or other agencies working in the area. Similarly, regional population data usually are available from regional government offices. In refugee camps, you should be able to get population data from the United Nations High Commission for Refugees (UNHCR) or NGOs working in the camp. If no population data are available, for example for newly displaced people or refugees, a rough population estimate can be made by estimating the number of dwellings and the number of people in each dwelling.

The next step is to choose the most appropriate sampling method to use.

Simple random sampling: When a list of every household or individual (and if possible the location) is available, individuals are randomly chosen from the list using a random number table. This is an uncommon situation and so is rarely used.

Systematic random sampling: Systematic random sampling is used when there is either a list of households or where the population is geographically concentrated and all the dwellings are arranged in a regular geometric pattern. Such a situation may occur in a camp where tents are pitched row after row, in blocks of flats, where streets are laid out in a grid, or where the houses are all along the edge of a river, coast, road, or other major feature. The first household is chosen at random. The subsequent households are visited systematically using a "sampling interval"; this is determined by dividing the total number of households by the number needed to give an adequate sample.

Every house should have an equal chance of being chosen before the first house is selected. This method is usually used for small-scale surveys of limited areas. This method is also frequently used to select the households to sample within a "cluster," as explained below.

Cluster sampling: This most common form of sampling is done in two stages. First, the whole population is divided, on paper, into smaller discrete geographical areas, such as villages[22] whose population is known or can be estimated. Clusters are then randomly selected from these villages with the chance of any village being selected being proportional to the size of its population. This means that each person in the whole area has an equal chance of being selected.[23] This is called sampling with "probability proportional to population size." In the second stage, the individuals are chosen at random from within each cluster area or village.

[22] The term "village" is used throughout the manual for convenience. It is used here to denote any area, where people live that has been given a name by the local authorities or population. This may be a traditional village, part of a town or city, subdistrict, or even a rural area bounded by geographical features such as a stream or river. When the area is named, the population knows the boundaries of the area, and the authorities either know or can estimate the population of the area.

[23] Although larger villages are more likely to be selected to contain a cluster than smaller villages, individual households within the larger village are less likely to be sampled than a household from a small village. These effects balance each other so that each household in the whole population has an equal chance of being selected.

4.4.1.1 Population data

The population data may be very inaccurate or out of date, particularly if there has been population movement due to an emergency. As many sources of information as possible should be used to list all known villages in the area to be surveyed. If the population figures are unavailable, use local knowledge to assign a relative size to each village. The survey team, especially the enumerators, can further assist in verifying or providing population estimates—more so if they all come from the study area. A starting village, A, is used and the other villages described in terms of their relative size (X is half the size of A, Y is twice as large as A, etc.). These factors are then used to give the villages weights. Sometimes only vague descriptions are available, e.g., very big, big, medium, small, and very small. These descriptions can also be used to weight villages[24] for sampling proportional to population size.

4.4.1.2 Inaccessible areas

A common problem occurs when parts of the population within the sample area are not, or cannot be, sampled. In some countries, surveys can only be conducted within a radius from an airstrip or road. In others, there are areas that cannot be accessed because of insecurity, impassable roads, and rivers or mountains. While the results are often presented as representative of the whole area, it is incorrect to do so. A map showing the accessible areas that are included in the survey should always be presented with the report, and it should be made clear what areas are excluded.

Nobody expects surveys to be done in inaccessible areas, and the surveyors will not be criticized for omitting such areas. However, they will be criticized for claiming that they have included areas that are, in reality, inaccessible. The report can legitimately discuss whether inaccessible areas are likely to be better or worse off than the surveyed areas. (Besides the inaccessible/insecure areas, deserted villages/settlements (in pastoral communities) should also be omitted from the sampling frame).

4.4.2 Calculating sample size

With any particular study design, the calculation of the sample size depends on the following decisions:

1. How wide a confidence interval can be tolerated? This determines the minimum precision around the estimate of malnutrition or death rate that will result in a useful result.
2. What are the expected malnutrition prevalence and death rate?
3. What is the likely design effect (if the survey is to use cluster sampling)?

[24] It is unclear what relative sizes should be given to these descriptions; for example very big = 2,500, big = 1,600, medium = 900, small = 400, very small =100; or very big = 500, big=400, medium=300, small=200, very small=100. It is normally better to take one typical village that everyone knows and then describe the other villages in terms of fractions or multiples of the index village.

4.4.2.1 How do you make these decisions?

1) *How wide a confidence interval can be tolerated?* The first consideration is the minimum precision needed to meet the objectives of the survey. If a survey is done to determine whether one third or more of the population is malnourished, or there is a gross elevation of death rate, for example, then much less precision is needed than for a survey designed to estimate whether there has been a change since a similar survey conducted three months previously. The desirable precision and expected malnutrition prevalence/death rate are interconnected. If there is a very high prevalence of acute malnutrition—say 40%—the precision does not need to be high to enable agencies to make appropriate decisions. At a prevalence of over 35% or so, services will be overwhelmed, and urgent and substantial intervention will be needed. A confidence interval of plus or minus 10% is perfectly acceptable under these circumstances. In general, the lower the prevalence the greater the precision needed. A survey that gives a prevalence of malnutrition of 7.5%, but with a confidence interval of 0%–15% is not sufficiently precise to decide whether to intervene, as the confidence interval encompasses no malnutrition at all to a substantial proportion of the population. In this situation, such a low precision survey would be useless for making program decisions.

2) *What are the expected malnutrition prevalence and death rates?* The higher the malnutrition prevalence or death rate, the lower the precision obtained with a fixed sample size. However, as we have seen, with a high rate of malnutrition, lower precision is perfectly acceptable. There are ways you can guess the ranges within which the malnutrition prevalence and death rate are likely to lie. When making this assessment, always decide upon a plausible range of values rather than a single value. "Given the situation, the malnutrition prevalence is unlikely to be above 20% or below 10%" would be a reasonable statement in many situations. There may be surveillance data that include proportions of children presenting to clinics with malnutrition; a prior survey or one in an adjacent area of the country may have estimated these outcomes; or persons who have worked with the population since a previous survey may have a sense of whether malnutrition or mortality has become more or less common. A more general impression can be also obtained by asking health workers if they see many thin children. Religious leaders should be asked how many funerals they have conducted recently, the approximate size of their congregations, as well as whether the number of funerals has increased or decreased recently.

3) *What is the likely design effect?* For calculating sample size for cluster sampling, a correction factor accounting for heterogeneity among clusters in the population must be used. This factor is called the "design effect." Using cluster sampling requires a larger sample size than for simple or systematic random sampling. This is because subjects within the same cluster are generally more similar to each other than to members of different clusters, which results in a decrease in precision. The imprecision of cluster sampling is compensated for by multiplying (increasing) the sample size calculated for a simple random sample by the design effect.

Design effects can vary from 1 (if the population is homogeneous so that all the clusters are similar to one another) to 4 or higher where some clusters are not affected and others are severely affected. For example, if you think that malnutrition is more or less the same throughout the population, then the design effect is probably low. In most emergencies, the design effect for malnutrition is about 1.5, increasing to 2 or more in more heterogeneous or large-scale surveys.[25]

If you anticipate that crude death rate or malnutrition prevalence is quite different in different parts of the population, the design effect may be high and a value of at least 2 should be used in the calculation. If the design effect is thought to be much greater than 2, the population is probably sufficiently heterogeneous that two separate surveys should be conducted, each focused upon more homogeneous sections of the population. Two cluster surveys, each with a design effect of 1.5, can be conducted with the same effort as one survey with a design effect of 3.

In emergencies where violence causes a large proportion of deaths, the violence is very rarely evenly distributed in time or place, and the design effect can be very high (up to 10). Such high design effects require very large sample sizes if meaningful data are to be produced.

The best sources for estimates for the design effect are usually prior surveys done in the same, adjacent, or similar populations. Design effects from prior surveys should not be used directly to calculate sample size for a survey if there are very different numbers or sizes of clusters, or if there is a reason to think that the heterogeneity of malnutrition or death has changed due to the present crisis.

Table 2 shows the minimum sample size calculated for various prevalence of wasting, and the level of precision that is commonly asked for in conjunction with the anticipated prevalence. The column showing a design effect of 1 is for use with simple random or systematic random samples; those showing a design effect of 1.5 or 2 are for cluster sampling.

Table 2. Precision necessary at various levels of malnutrition prevalence

Malnutrition prevalence	Desired precision	Sample size		
%	+/- %	Design effect = 1.0	Design effect = 1.5	Design effect = 2.0
5	2.0	456	684	912
10	2.5	553	830	1,106
15	3.0	544	816	1,088
20	5.0	246	369	492
30	7.5	143	169	287
40	10.0	92	138	184

It is usually not feasible to achieve a precision greater than 2%. It has become common practice to use a sample size of 900 for cluster samples (30x30). In practice more than 900 children are very rarely needed in a survey. If a much larger sample size is generated by the calculations, you are perhaps aiming for an unrealistically precise result. It is usually possible to use fewer than 900 children, which in turn makes the logistics of the survey much simpler and may reduce bias. Thus, we strongly recommend that the survey supervisor use Nutrisurvey to calculate the number of children needed for each survey.

[25] The decision about severe malnutrition is more complicated, because the design effect for edema is normally greater than for moderate or severe wasting. There is insufficient information at the moment to make recommendations about the design effect for edematous malnutrition (kwashiorkor).

It is clear that when there is a major catastrophe with a very high level of malnutrition, high precision is not required to decide whether to intervene, and a relatively small survey is sufficient. In this case, the survey can be conducted and reported much more rapidly.

At the levels of malnutrition and mortality generally found in emergencies, the decision about precision has a much greater effect on the sample size than the suspected prevalence of malnutrition or death rate. Table 3 shows the effect of a small increase in the desired precision upon the sample size. If the malnutrition rate is thought to be about 10%,[26] to achieve a confidence interval of 8%–12% will require up to 1,729 children; however, to achieve a confidence interval of 7%–13% will require less than half that number: 768 children.

Table 3. Effect of increasing desired precision on sample size at constant malnutrition prevalence

Malnutrition prevalence %	Desired precision +/- %	Sample size		
		Design effect = 1.0	Design effect = 1.5	Design effect = 2.0
10	2.0	864	1,297	1,729
10	2.5	553	830	1,106
10	3.0	384	576	768

There is no "standard" precision; this is a judgment derived directly from the survey objectives. The supervisor must consider the likely results and whether a wide confidence interval is tolerable or a narrow confidence interval is necessary to make program decisions. Another consideration is whether the survey results will be used in the future to determine whether the prevalence of malnutrition or death rates are increasing or decreasing. In the latter case, a higher precision is desirable, even though a lower precision may be adequate for immediate planning requirements.

The sample size estimates in tables 2 and 3 are not really "accurate" to the nearest child. They give a false impression of accuracy because the formula yields results to the nearest one child. Given the uncertainty of the estimated ranges of prevalence and the design effects that are entered into the formula, the numbers produced by the formula are equally uncertain.

The advice to anticipate a range of likely values for the prevalence and for the design effect, within which you anticipate the results will fall is important. In Nutrisurvey you should enter

- the *widest* confidence interval that is acceptable
- the *highest* prevalence that is anticipated
- the *largest* design effect that is likely to be encountered

[26] A 10% prevalence has been used by some agencies as an action level to intervene. If this is the case, a relatively high precision is needed if the prevalence is thought to be around this cutoff point. For various reasons, we do not recommend that 10% be used as an action point.

The first choice will minimize the sample size needed, whereas the latter choices will increase it and likely result in a higher number of children being surveyed than will be found to have been absolutely necessary. Nevertheless, it is much better to include a few extra children in the survey than to have to repeat the whole survey because there were insufficient children chosen during the planning stage, or to make critical program decisions on insufficiently precise data. When there is a prior survey, the anticipated prevalence and design effects can be chosen with narrower ranges so that subsequent surveys should be more efficient than the first one that is attempted in an unsurveyed population.

After the sample size has been calculated using Nutrisurvey, the number should be increased slightly and rounded up to a convenient number that is a multiple of the number of clusters. This is to allow for contingencies such as being unable to measure all the children in selected households, having to exclude data during the "cleaning" process where implausible results are discarded, or visiting households where there is no reliable respondent for the mortality questionnaire. In general the sample size is normally increased by 5% to 10% to allow for these and other unforeseen contingencies.

When the combined survey is designed, the sample size to estimate the prevalence of malnutrition and the number of households that need to be interviewed to estimate the mortality rate are both calculated, and the greater number should then be chosen for the combined survey.

4.4.2.2 Calculating sample size to estimate death rates

For the mortality section of the survey there are additional considerations involved in calculating the sample size.

The same underlying formula is used to calculate the sample size needed to estimate the death rate. The calculation is not as straightforward as it is for sampling for prevalence of wasting, and it is recommended that Nutrisurvey be used for the calculation.

There are two additional factors that need to be considered in making the calculation:

- Recall period: the longer the recall period the fewer subjects need to be considered.
- Household size: the larger the average household size the fewer households need to be visited.

The following tables give examples of the number of households that will need to be interviewed with various CDR and levels of precision (assuming an average household size of five 5). As with wasting, the higher the CDR the less precision that is generally required. Table 4 shows the sort of precision that is sought at different levels of CDR.

Table 4. Desired precision and households to be surveyed in mortality surveys at various levels of CDR

CDR, /10,000/day	Desired precision, /10,000/day	Recall period (days)	Household size	Households to sample		
				Design = 1.0	Design = 1.5	Design = 2.0
0.5	0.30	90	5	472	708	944
1.0	0.40	90	5	529	793	1,058
1.5	0.50	90	5	505	758	1,011
2.0	0.75	90	5	298	447	596
3.0	1.00	90	5	249	374	498

A CDR of 1/10,000/day is the level that is often used to declare an emergency. Table 5 shows the numbers of households that would need to be interviewed with various levels of precision and a recall period of 90 days (3 months). It is generally not possible to achieve a precision much greater than 0.4 deaths/10,000/day with a survey of a reasonable size and a three-month recall period. If higher precision is required, the recall period would need to be lengthened.

Table 5. Households required for various levels of precision in mortality surveys

CDR, /10,000/day	Desired precision, /10,000/day	Recall period (days)	Household size	Households to sample		
				Design = 1.0	Design = 1.5	Design = 2.0
1	0.3	90	5	940	1,410	1,880
1	0.4	90	5	529	793	1,058
1	0.5	90	5	338	508	677

Table 6 below shows the effect of changing the recall period. At a mortality rate of 1/10,000/d increasing the recall period to from 90 to 120 days has an dramatic effect upon the possible survey designs that are open to the supervisor; an unwieldy survey may become feasible with a reasonable effort. At this death rate a recall period of 60 days is insufficient to produce a reasonable precision and a straightforward survey.

Table 6 also shows that when the mortality rate is very high (3 and above), then not only are wide confidence intervals acceptable, but the recall period can be shortened considerably while still having a reasonable sample size. If there is a very high mortality that lasts for a long time, a large proportion of the population dies. Such a situation is usually clear. Generally, an acute emergency with a very high mortality is relatively short lived, and it is appropriate to have a short recall period that covers the time of the acute emergency.

Table 6. The effect of changing recall period in mortality survey sample size calculations

CDR, /10,000/day	Desired precision, /10,000/day	Recall period (days)	Household size	Households to sample		
				Design = 1.0	Design = 1.5	Design = 2.0
1	0.4	60	5	796	1,193	1,591
1	0.4	90	5	529	793	1,058
1	0.4	120	5	395	593	791
3	1.0	45	5	505	758	1,011
3	1.0	60	5	377	566	754
3	1.0	90	5	249	374	498
5	2.0	30	5	315	473	631
5	2.0	45	5	209	313	417
5	2.0	60	5	155	233	311

These examples show the importance of calculating a sample size for each survey. With the mortality survey the variables that need to be entered into Nutrisurvey are

- anticipated CDR (deaths/10,000/day)
- desired precision (deaths/10,000/day)
- recall period (days)
- household size (number of people)
- the design effect (for cluster surveys)

4.4.2.3 Sample size calculations for 0–5DR

Data are normally collected for the children under 5 years old in the camp, and the 0–5 DR calculated and presented in the report. However, because the 0–5-year-olds form 15–20% of most populations, the sample size for these children obtained from the household interviews will be about one fifth of the sample size for the CDR. The precision around the estimate is correspondingly poor. If a similar precision is required for the 0–5DR as for the CDR, then it is necessary to undertake a separate mortality survey to obtain these data specifically. The precision of the 0–5DR is not normally considered when designing a combined nutrition/mortality survey.

4.4.3 Methods for choosing households for anthropometric and mortality surveys

In statistical terms, all sampling methods are equivalent, as long as they result in a representative sample. The sampling scheme that should be chosen is determined mainly by the size of the population and the physical area and organization of the households.

4.4.3.1 Simple random sampling

Simple random sampling is used where there is an up-to-date list of all individuals or households in the population, with enough information to allow them to be located. It is generally only used for small populations and is the most straightforward method.

Households (individuals) are randomly chosen by using the random number procedure in the planning sheet of the Nutrisurvey software. In practice, a reliable population list is rarely available. In a very small population, all the houses can sometimes be enumerated and given numbers by the survey team. The sample is then chosen from these houses using the software.

4.4.3.1.1 Steps for choosing households using simple random sampling

1. Determine the number of households that need to be visited from the estimated sample size.

    a. For the nutritional survey, we either know or calculate the average number of children per household (say 0.9 children per household). If we need to sample 344 children for the survey, 382 households (344/0.9) will need to be visited to complete the nutritional sample.

    b. For the mortality survey, we either know or calculate the average number of household members (say 4.55). If we need to sample 2,105 people for the survey, we need to visit 463 households (2,105/4.55) for the mortality component.

    c. The number of households to be visited is the greater of the two components of the surveys. This normally results in a greater number of subjects than necessary in one or other component of the survey.

2. Determine which households will be visited by entering into Nutrisurvey the total number of households in the population and the number required for the sample. Nutrisurvey will select the required house numbers at random. It will then sort them into a list in ascending order to simplify visiting each house.

3. Measure all the children in each selected house and record their measurements on the datasheet. Complete the mortality questionnaire for each household, even if the household has no children.

4.4.3.2 Systematic sampling

This method is used in relatively small geographic areas where there is an orderly layout of the houses that make it possible to go systematically from one house to another, in order, without omitting any of the houses. Usually the houses are mapped and can be numbered. Accurate population data are not needed for systematic sampling.

4.4.3.2.1 Steps for choosing households using systematic sampling

1. Determine the number of households that need to be visited for the mortality survey and the number children required for the nutritional survey using the Nutrisurvey software.
2. On the map of the site, trace a continuous route that passes in front of every household (figure 2).[27]

[27] If the households are in neat rows, such as tents in a refugee camp, it is not necessary to draw a map.

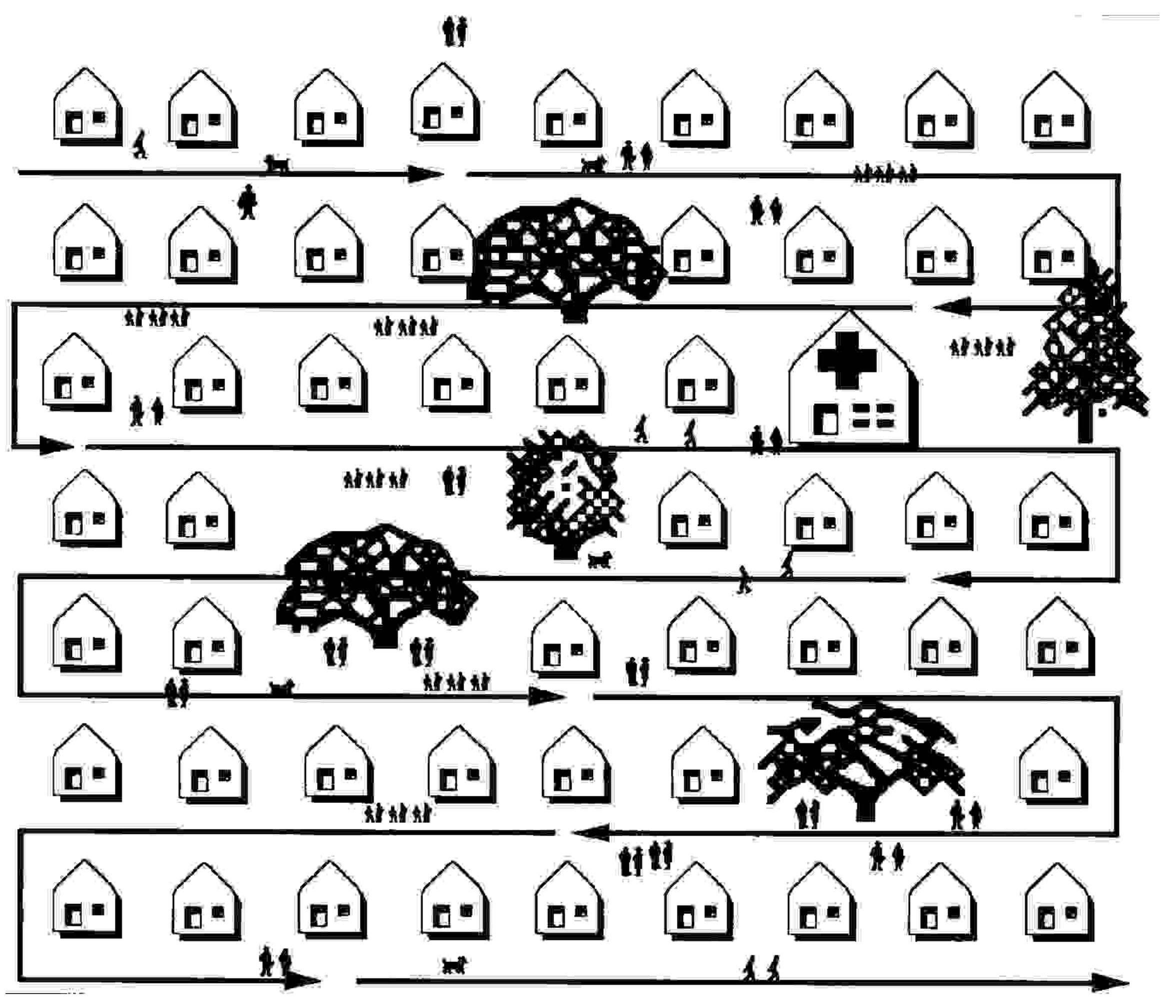

Figure 2. Example of a community where systematic sampling is possible
Source: MSF, in press

3. Determine the number of inhabitants and the number of households in the population (let us assume 50,000 people and 11,000 households as an example).
4. Estimate the number of children aged 6–59 months in the population. This can be estimated either from knowledge of the average number of children per household or the proportion of children in the population (example 10,000 children).[28]
5. Calculate the number of households required.
    a. For the nutritional survey, we either know or calculate the average number of children per household (example 10,000/11,000 = 0.9). If we need to

[28] In the least developed countries, characterized by high baseline mortality and birth rates, about 20% of the population are under age 5. In more developed countries, the proportion is lower. Useful data can be obtained from MICS or DHS survey reports or other surveys that have collected household census data.

sample 344 children for the survey, 382 households (344/0.9) will need to be visited to complete the nutritional sample.

b. For the mortality survey we either know or calculate the average number of household members (example 50,000/11,000 = 4.55). If we need to sample 2,105 people for the survey we need to visit 463 households (2,105/4.55) for the mortality component.

c. The number of households to be visited is the greater of the two components of the surveys (a greater number of subjects than necessary will thus be included in one or another component of the survey).

6. Determine the “sampling interval” by dividing the total number of households by the number that must be visited. In our example, if the total number of households is 11,000, the sample interval = 11,000/463 = 23.7 (we may need to add 5%–10% of the needed households for contingency purposes as explained previously). You should round down to the nearest whole number. In this example, one household in every 23 should be visited.

7. Select the first household to be visited. The first household is randomly selected within the sampling interval (1–23) by drawing a random number that is smaller than the sampling interval using the Nutrisurvey software. For example, if the random number drawn is 5, start with the fifth house.

8. The next household to be visited is found by adding the sampling interval to the first household selected (or counting the number of households along the prescribed route). In the example, 5 + 23 = 28. Continue in this way so that you visit house number 5, 28, 51, 74, 97, and so on, until all selected households have been visited. Theoretically, both the mortality and nutrition survey should be completed in all the preselected households, even if this means that more children/subjects are included than are needed from the calculations of sample size.[29]

9. Measure all children in each selected house and record their measurements on the datasheet. Complete the mortality questionnaire for each household, even if the household has no children.

4.4.3.3 Cluster sampling

Two-stage cluster sampling is used in large populations where no accurate population register is available and households cannot be visited systematically. This is the most common situation in most populations. Cluster sampling usually reduces the distance the survey team has to walk. However, the sample size is always greater so that more households need to be visited.

The sampling is split into two stages:

[29] If the survey is halted as soon as sufficient subjects are included, the people in the households at the “end” of the village are less likely to be sampled than those sampled at the beginning. However, if the sampling is halted as soon as there are sufficient children/subjects, it is unlikely to introduce a major bias, provided that the sampling interval has been correctly chosen and the team is “close” to the end of the area when the survey is halted.

- Stage one: The villages with the clusters, or sampling sites, within the total population are selected randomly according to their size.
- Stage two: The required number of houses within each cluster are selected and visited.

4.4.3.3.1 Stage one: Selecting the cluster

Cluster sampling requires the grouping of the population into smaller geographical units like villages (figure 3). The smallest available geographical unit is always chosen, as long as population data are available and the geographical unit has a name. If village data are available, use these localities as the geographical unit. If village data are not available, use districts. If there are no population data, draw a map of the area and, with someone who is familiar with the area, roughly divide the area into sections of about equal size, following as far as possible existing geographic or administrative boundaries. Each area should have a local name, so that the inhabitants are familiar with the boundaries of the area when the local name for the area is used. Each section should have at least the number of households required to form a complete cluster. If there are insufficient houses

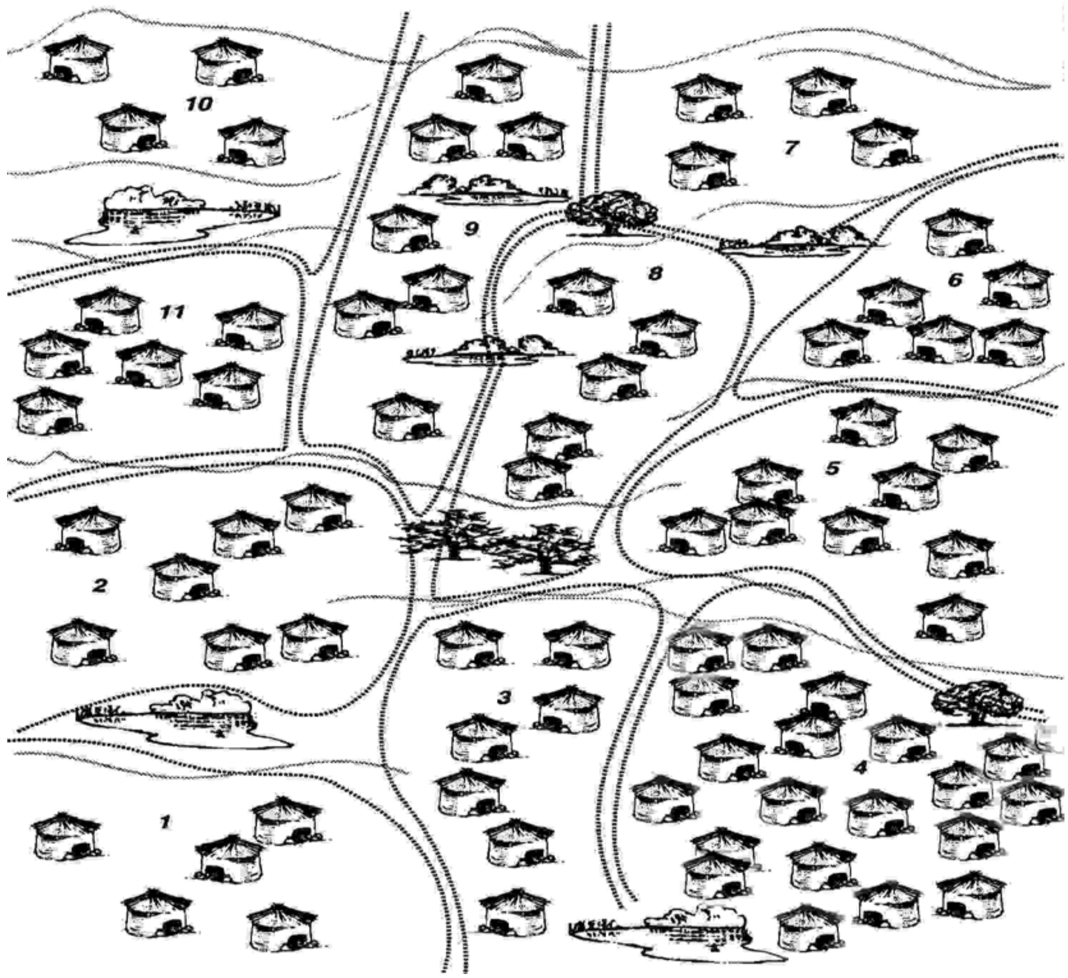

Figure 3. Example of a community where two-stage cluster sampling is needed

in a village, two adjacent villages should be combined at the planning stage.

The selection of the sections (from which a cluster will ultimately be chosen) must be conducted so that the chance of any particular section being selected is proportional to the population of the section. Thus, if one section has a population of 5,000 and another 1,000, then the first section has five times the chance of being chosen to contain a cluster. This is the main reason why (approximate) population data are required.

Steps in choosing the clusters:

1. Determine the sample size using Nutrisurvey.

2. Obtain the best available census data for each village, district, or section on the map. This is usually obtained from the local government offices. In a stable population, such as a drought-affected region with little in- and out-migration, a census that is several years old may still be acceptable as a base for population proportionate sampling. However, in refugee situations where influx continues, reliable up-to-date counts are important for a valid sample. Alternatively, if no population data are available, estimate the relative size of the population living in each section of the map using a key informant.

3. On the planning page of Nutrisurvey (right-hand side of pane) there is a table. Enter the names of all the villages (districts or sections on map) into the left column and their population size into the right-hand column. The order you enter the villages is not important, but it is important that they *all* be included.

The Software will automatically select the villages that should contain a cluster.

You will not be able to change a cluster site once it is selected. If the survey is to be unbiased, the selected site must be visited. Thus, it is important to define your geographical area in the planning stage very realistically, taking travel, security, and any other factor that could influence your ability to get to the cluster site into account before listing the sites in the planning table.

Large villages or sections of towns may be selected for more than one cluster. If this happens, the village should be divided in two equal sections geographically (say north and south) and one cluster taken at random from each division.

4.4.3.3.2 How many clusters should be selected?

The number of children in a cluster should generally be chosen so that one team can complete one cluster per day. If it is anticipated that the teams can only measure, say, 20 children per day, then the best strategy is to increase the number of clusters. The design effect is smaller with a larger numbers of clusters, meaning that although there may be more clusters, fewer total numbers of children are likely to be needed. Thus, sampling 40 or 45 clusters of 20 children is more efficient than 30 clusters of 30 children.

If the teams leave base at 8 am, take one hour to reach the cluster site and another hour to introduce themselves and select the first house, then measurements will start at 10am. The team will need two refreshment breaks of 15 minutes each, one hour for lunch, and will need to leave to get back to base before dark, say about 4pm.[30] This means that the team will have 4.5 hours to measure children and interview household heads. If 30 households are to be visited, there will be about 7 minutes for each child and interview, with 2 minutes to reach the next house and introduce the team to the new house. Thus, all the data that is to be gathered from a family should be able to be collected in about 7 minutes. If there are 20 visits to be made in the same time then the team can spend 11.5 minutes at each house. With only 15 visits per cluster, the team could spend 16 minuets at each house. These practical points should be considered when designing the survey. If the distances between houses are not great and there is no insecurity, more children can be included in a cluster. This is one reason why sample size should always be calculated to have the minimum number of visits that is compatible with the desired survey precision.

In households where the mother is not the respondent for the mortality interview, it is possible to conduct the interview and make the measurements on the children simultaneously (if there are separate team members for interviewing and measuring). However, in most households the mother will need to be interviewed. She should also be with her children when they are measured if they are not to be frightened by the team (of strangers). Thus, the two components of the survey will often need to take place consecutively even if there are additional team members. (The interview should always take place before the anthropometric measurements. During the interview, the children will "settle down," see that the mother interacts with the team harmoniously and be more amenable to being measured).

Some houses will have to be revisited at the end of the day to measure children that were missing during the first visit. If the time scale simply cannot be kept, there are two choices. The team could use two days to measure one cluster, which will double the time taken to collect the data. This is undesirable. Alternatively the number of children in each cluster can be reduced and the total number of clusters increased, affording more time to carefully collect data. This is a far better option.

Thus, if data from 30 children, for example, cannot be collected in one day during the field test at the end of the training session, the number of clusters should be increased and the number of children in each cluster correspondingly reduced.

The commonly used 30 by 30 cluster survey design is calculated to cover nearly every situation and give a relatively high precision when there is a high prevalence of malnutrition. It is designed to accommodate "worst case" situations, ensuring that nearly all surveys will have sufficient children regardless of the experience of the surveyor. In general it is found that most surveys could have been adequately conducted, more cheaply and rapidly, with fewer children. To avoid "shortcut" bias, it is better to measure fewer children accurately than overstress the team so that the measurements are not made accurately (see example in Box 8).

You should always plan to have *at least* 30 clusters. As the number of clusters decreases, the design effect increases rapidly, and fewer than 26 clusters can yield unreliable results.

[30] Before leaving, the teams will need to attend the briefing meeting, check their equipment, obtain their refreshment, fuel the vehicle, etc. Adequate rest and refreshment are essential and time must be allocated. In emergency situations, it is inadvisable to travel after dark.

Box 8. Sampling scenario
A team was working in very difficult terrain and could visit about 18 households per day. If the total sample size was calculated to be 720 children, then the planners should plan to have 40 clusters of 18 children in each cluster, not 30 clusters of 24 children each. Using 24 children per cluster, the teams would have to spend two days at each cluster site. Suppose an initial design effect of 2.0 was used for the sample size calculation. As the number of clusters is increased, planners could decided to reduce the design effect to 1.8. This, in turn, would reduce the desired sample size from 720 to 648, and the survey could be revised to include 36 clusters of 18 children each. Four teams could complete the data collection in nine days in comfort without being harassed. If the planners insist on 30 clusters, each team having to spend two days at each cluster, the team would spend the first day measuring 18 children and the second day 6 children. The survey would then take 15 days for four teams to complete, and the survey would probably be of lower quality. This illustrates the importance of doing a sample size calculation for each survey, having a cluster size that the team can easily complete in one day, and choosing a realistic design effect.

In practice, even under difficult conditions, teams can manage at least 15 households per day, meaning that if the total sample size is 450 or less there should be 30 clusters.

4.4.3.3.3 Stage two: Selection of households to form the clusters

There are several methods of choosing the households from the cluster. The best way is to treat each cluster as if it is a "small population" and to select the houses using the simple or systematic random sampling methods described above. If the cluster is to be taken from a larger population, the first step of stage two is to subdivide the population into segments of roughly the same number of people. One of these segments is then chosen from the random number table. In this way the "village" is reduced to an area containing up to 250 households. These households are then listed, and the required households selected from the list by simple or—if they are arranged in some logical order—systematic random sampling.

If it is not possible to select the households in this way, the "EPI" method can be used. Although, this method is simple, widely known, easy to train, and rapid, it results in a somewhat biased sample.[31] However, the time taken to select the sample and move from house to house is far less when the EPI method is used.[32]

[31] This is because households closer to the center are more likely to be selected. Consider a village with houses arranged in concentric circles around the center. If each house occupies the same area, the number of houses in each circle will be about six times as many as in the circle closer to the center. If a direction is selected, a particular house on the peripheral circle has a much lower chance of being selected than one near the center. Second, because "proximity" sampling is used, all households selected for the cluster are more likely to resemble each other than more remote houses in the village. Because of this inherent bias, this method is not recommended. However, there are many situations where using random sampling methods is not feasible.

[32] There have not been sufficient studies where the two sampling methods have been compared at "cluster" level (for either nutritional or mortality surveys) to determine the extent to which this bias influences the results of the survey and the "design effect." Because the EPI method is simpler and quicker, research to determine the extent of the bias introduced into nutritional and mortality surveys is urgently needed. When the results of such research become available, the recommendations of this section may change.

4.4.3.3.4 Steps in using the EPI method

When the team arrives at the village that will contain the cluster, the following procedure should be followed after discussions with the village leaders:

1. Go to somewhere near the center of the selected cluster area.

2. Randomly choose a direction by spinning a bottle, pencil, or pen on the ground and noting the direction it points when it stops.

3. Walk in the direction indicated, to the edge of the village. At the edge of the village spin the bottle again until it points into the body of the village. Walk along this second line counting each house on the way.[33]

4. Using a random number list select the first house[34] to be visited by drawing a random number between 1 and the number of households counted when walking. For example, if the number of households counted was 27, then select a random number between one and 27. The team will not have a computer in the field, so each day[35] before setting out, the supervisor should print out the list of random numbers. If the number 5 was chosen, go back to the fifth household counted along the walking line. This is the first house you should visit.

5. Go to the first household and examine *all* children aged 6–59 months in the household for the nutritional survey and complete the mortality questionnaire.

6. The subsequent households are chosen by proximity. In a village where the houses are closely packed together, choose the next house on the right.[36] Continue in this direction until the required number of children have been measured and subjects enumerated for the mortality survey. The same method should be used for all the clusters. If the village is spread out, choose the house with the door closest to the last house surveyed, whether on the right or left; this saves a lot of time in an area where the dwellings are spread out. Continue the process until the required number of children has been measured.

4.4.4 When the house is selected

4.4.4.1 Too many children

In cluster sampling, when the last house is visited to get the last child in a cluster, there are often several children in the household. If so, they should *all* be measured and

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[33] As the houses closer to the center are more likely to be on the walking line from the center, this modification of the standard EPI method is suggested to reduce bias when the walk is started from the center of the village.

[34] It is important to carefully define a household. It is usually defined as a group of people who regularly eat together from the same cooking pot, but those that contribute to a common economy or sleep in the same compound may be more appropriate. The definition has to be decided at the planning stage, and the same definition applied by all teams consistently. Polygamous families may constitute one or more households.

[35] These can be generated and printed when planning the survey. One list is printed for each cluster and numbered 1 to 30 (or whatever the total number of clusters). The team then takes the random sheet with them when they visit the village.

[36] Or left, but this should be decided during the planning stage and the same rule should be used by all the teams. It is more convenient to always go to the right for every survey.

included in the sample. Thus, if the planned cluster size is 25, some of the clusters will end up with one or two more children in the cluster. This is expected.

In systematic sampling, the plan for selecting houses should be followed and all the children in the houses measured, even if this means that more children are measured than calculated by the sample size.

4.4.4.2 Not enough children

In cluster sampling, if the team runs out of houses to measure in a village (e.g., they go to all the houses in a village) without identifying enough children, it will be necessary to go to the next nearest village to complete the survey. When they arrive at the next village, the process of selecting a house at which to start is repeated. Proceed from house to house until a sufficient number of children have been measured.

In systematic sampling, if the team has finished going to all the houses planned and there were insufficient numbers of children, the whole sampling procedure needs to be repeated to select the remaining children. This is done by finding a new sampling interval and a new starting point. In the example given above, if another 40 children are needed then the new sampling interval (11,000/40) will be 275. They also need a new random starting point—say 193. They now need to visit every 275th household, starting at house 193, to find the remaining children. This is tiresome and doubles the work to find a few extra households. It is important not to overestimate either the proportion of children aged 6–59 months or the average household size when calculating the sampling interval. If the sampling interval is too large the total number of children measured will not be enough. The sampling should not end when the predetermined number of children is found; it should continue until all the houses that were selected are visited, even if there are additional children and subjects for the morality survey; they form part of the sample.

4.4.4.3 No substitution

In each of the methods of selecting houses, whenever a house is selected according to the rules, there should not be a substitution for this house for any reason. House occupants sometimes refuse to be measured, the staff sometimes fear dogs, local people may try to direct the team to include particular houses and omit others, or houses may be deserted or physically difficult to reach (up a steep hill for example). If for any reason the selected house is not included, the team must make a note and go to the next house according to the rules. Another house is not substituted for the properly selected house. This is not usually a problem with the EPI method, because the rules say that the nearest house to the right should be the next selected. (In this case, however, a house to the left should not be substituted.)

4.4.5 In the house

Regardless of the sampling method, the house is the unit that is selected. Before it is visited, it is not known how many children are in the household, or whether there are any children at all.

4.4.5.1 Measure all the children

All the children living in the house in the correct age range should be included in the sample and measured. If two eligible children are found in a household, both are included, even if they are twins. This is extremely important, as it ensures that every child has the same chance of being selected, which is a basic principle of the survey design. Some agencies used to select a single child to represent a household, reasoning that the other children would have a similar nutritional status. Surprisingly, detailed analysis has shown that there is little correlation between the nutritional status of children living in the same household. Individuals, rather than households, seem to become malnourished.

4.4.5.2 No children

For all the sampling methods, if there are no children under age 5 in a household, the house should remain a part of the "sample" that contributes zero children to the nutritional part of the survey. However, it is very important to include this house for the mortality survey. Collect the data on mortality and any other data that forms part of the survey, record the household on the nutritional data sheet as having no eligible children, and proceed to the next house according to the rules. On the datasheet, there is normally one line for each child. In cluster sampling, this goes up to the number of children chosen for the cluster plus three because the last house that is visited may have more than one child. The next lines on the data sheet should be used to record households with no children in them and the household is given a "household survey number." With systematic sampling go to the next selected house according to the plan (in the example, if there are no children in house 23, then collect the mortality data and go to house 41, but *never* to house 22 or 24. It is important that the households are recorded with an identical identifying number on the nutritional data collection forms and the household census/ mortality forms.

4.4.5.3 Empty houses

If the house is empty, the neighbors should be asked about the family that lives in that house. On the data collection form, record why the house is empty (if this can be determined). If the residents are likely to return before the team leaves that cluster, the team should return to the house to include the residents in the survey. If the house is permanently empty or the residents will not return before the team must leave, this house can be skipped and a note made. If the house is empty because all the members are dead, the neighbor should be interviewed and all the residents recorded as having died. Again, do not substitute a house that is not in the original sample for the empty house.

4.4.5.4 Absent children

If a child lives in the house but is not present at the time of the survey, this child is recorded on the datasheet when the house is visited. Of course the weight and height cannot be entered at that stage. Tell the mother you will come back to the house later in the day, after you have been to all the other houses in the cluster or systematic sample. Then go back to the house to find the child. The team should continue to look for missing children until they leave the survey area. There are always some children who cannot be weighed or measured, and this needs to be recorded and reported. The team should not simply take another child and forget about the child that is missing. If more than 5% of the children in a survey are not found, the teams should revisit the area at another time to see if they can complete the sample.

4.4.5.5 Disabled children

Disabled children that would otherwise be eligible should be included where possible. If it is not possible to measure height and weight due to deformity or other abnormality, the child should be given an ID number and the data recorded as missing (and a note taken). Of course, with missing height, they will not be included in the final sample unless they have edema.

4.4.5.6 Child in a center

If a child has been admitted to a hospital or feeding center, the team must go to the center and measure the child. This is critical, as such a child is very likely to be severely or moderately malnourished. If it is impossible to visit the center (it may be many miles away), the child should be included in the datasheet and a note added that the child was in a feeding center and probably severely malnourished. In reality, the child may or may not be severely malnourished. If there are a large number of such children, and the centers cannot be visited to complete the measurements, then two rates of severe malnutrition can be calculated, one assuming that these children are all severely malnourished, and the other excluding these children from the survey.

4.4.6 Problems often encountered

4.4.6.1 Population scattered over a large area

Population scattering is common in pastoral areas. The population numbers are usually very inaccurate and it takes a longer time to travel between sites and find the subjects. If the settlements are small it is essential to have more clusters, with fewer children per cluster, to ensure there will be a sufficient number of children at each site.

In some situations where the population is very spread out, you may deliberately choose to undertake a survey without sampling certain sections of the population. You might choose to sample only the population in larger settlements, which would save you the time and money needed to get into the bush to the more scattered population. This would mean you would not include population estimates from the scattered area when you are originally selecting your sample. As a result, you would have no accurate data about the nutritional status of children or the mortality rate in the population excluded from the survey. It is critical that the reader of the report not be misled: there must be a clear description of the exclusion in the report. The decision to exclude or include sections of the population, such as small groups of scattered nomads whose current whereabouts is unclear, will depend upon anecdotal reports of whether these groups are more or less affected than those that are more easily accessible.

4.4.6.2 Population is very mobile

If you are attempting to undertake a survey in an area of nomads where the population frequently moves large distances, it likely that you may travel to an area to find that there is no one there or nearby. If you suspect this might happen, you should select some extra clusters before you start the survey. This way, if one cluster is deserted you can replace it with another.

It is sometimes more appropriate to list the names of the nomadic groups, clans, or extended families themselves instead of villages or other fixed settlements. The clans to be sampled are then selected proportional to population size, and the teams set out to find the named groups within their migratory range. However, sampling of nomads is a highly specialized topic. Either the advice of an experienced epidemiologist should be sought, or nomadism should be a cited as a reason for exclusion. Occasionally in nomadic areas with a very sparse population, it is not possible to do a representative survey.

4.5 Training the teams

Training the teams is one of the most important aspects of doing a survey. It should not be rushed or assumed, as inaccurate measurements can have a very large effect upon the prevalence of malnutrition reported by a survey. As discussed, the Nutrisurvey software has certain checks built in to examine the internal structure of the data to see if the teams are consistent with each other, that the measurers are not rounding the values inappropriately, and that there are not large numbers of unlikely values. At the outset, it is important that the team knows that and the data they collect will be analyzed in this way, and that any shortcuts taken are likely to become apparent. However, there is no substitution for having a well trained, confident team that makes accurate and precise measurements. The software may recognize poorly conducted surveys, but it cannot correct them.

Team members have to understand the principles of doing a survey, the reasons why the survey is being done, and the likely interventions that could result depending upon the findings. They have to be comfortable with this knowledge and not confused. They have to be able to explain and answer questions from community leaders, fathers, and mothers. They have to be sufficiently well trained to be confident when they go into the community. They must also learn to select the houses, talk to the mothers, make the specific measurements, and record the results. This requires practice.

Survey members will be formed into teams. It is important that team members get on well with each other. Responsibilities, including the role of team leader, will be assigned at the end of the training. However, each team member should be able to perform all roles.

The training usually takes at least three days and should include the following:.

1. A clear explanation of the objectives of the assessment.
2. A clear explanation of roles and responsibilities of each team member, the team leader, and the survey supervisor (they should also be given a written “job description”).
3. An explanation of the sampling method that stresses the reasoning behind and importance of each child and household member having an equal chance of being selected (including households without children for the mortality survey). The idea of random selection is sometimes difficult to grasp. Games, such as taking counters from a bag, should be used to illustrate the principles.
4. A demonstration of weight and height measurements.

5. Practice taking height and weight measurements and assessing the presence of edema. After team members have practiced taking measurements, they are formally tested. For the tests, 10–20 children of different ages between 6 and 59 months are recruited. Each team measures each child in rotation. The teams go round two times so that each child is measured twice by each team. The data are entered into the computer during the training course. The software calculates how precise (ability to get the same result on the same child each time) and how accurate (how close the team is to "true" value, which is taken to be either the average or the supervisor's values) each team is in taking the measurements. After training and practice, any team member who is unable to measure and record the anthropometry of the children within the limits set by the computer program should be replaced or retrained.
6. Teams should visit a therapeutic feeding center, hospital, or clinic to see cases with edema and practice checking for edema with actual cases. Note that most cases encountered during a survey will have mild edema, and the teams should not be trained exclusively on cases with gross edema. It is very common for teams to make errors in assessing edema if they have only practiced on normal children, none of whom have edema.
7. An explanation of, and training in obtaining any additional data that need to be collected.
8. Instruction and practice administering the mortality questionnaire. Both male- and female-headed households should be visited. There should be at least twice the number of households as teams. Each team visits each household and administers the mortality questionnaire. As there is likely to be a "learning" effect by the respondent, each team should be the first to visit two of the practice households. The teams should get identical results.
9. A full-scale pilot test in the field. During the last day of the training, the team visits a village that is not part of the real survey, but is similar and convenient to the training location. The teams go through all the steps in conducting the survey, under supervision, in that village. Data collected during the pilot test should not be included in the survey results.

During the pilot test the teams will demonstrate the following:

1. They understand and can follow the sampling procedure. This means that the team will practice selecting the first house, the respondent(s), and children of the right age.
2. They can take and record measurements correctly under field conditions. This means that the team members will practice working as a team, each with his or her allotted tasks.
3. They can administer the mortality questionnaire.
4. They can interact amicably and effectively with the respondents.
5. They have the ability to organize the transport and care of the equipment.

At the end of the pilot test, the team members, leader, and survey supervisor should be confident that each team can undertake the survey accurately, and should know how long it takes to complete a survey of each household.[37] This information allows the supervisor to calculate how many households and children can be expected to be completed each day during the real survey. If this is excessive, any additional information being collected will need to be reconsidered.

4.5.1 Standardization of measurements

The standardization test consists of all the members of the teams measuring 10 (or more) different children twice, with a time interval between individual measures. The size of the variation between these repeated measures is calculated to assess how precisely each person measures the children (repeatability of measurements). Each team member's measurements are compared to the mean of the whole group to assess how accurately the measurements are made. Each team member is then given a score of competence in performing measures. Any misunderstandings or errors in technique are corrected during the training. Any team member unable to make the measurements sufficiently well should be replaced or given a different job in the survey that does not require taking the primary measurements.

The standardization exercise is performed with a group of children whose ages fall within the range for the study (6–59 months). Before carrying out the exercise, the supervisor carefully weighs and measures each child without allowing the trainees to see the values. The supervisor is automatically given the ID number 0, and should start by filling in the form. It is important that the supervisor undertakes the exercise as well as the team members. The supervisor's data may be assumed to be of higher quality than the trainees; however the actual values should relate closely to the mean value for all the teams.[38]

Each team member is also given a team-ID. For example, if you have 12 trainees, they should be numbered 1 through 12. Each child that will be measured is also be given a child-ID, starting from 1.

For the exercise, each child, with his/her mother, remains at a fixed location with the ID number clearly marked. The distance between each child should be far enough to prevent the trainee from seeing or hearing each other's results.

At the beginning of the exercise, each pair of trainees starts with a different child. The supervisor instructs the measurers to begin the measurements. The trainees should carefully conduct the measurements and clearly record the results on the second and third columns of the standardization form next to the child's identification number. Each pair of measurers should have their own form to complete, and each should take turns taking measurements. When each member of the pair has done the measurement, they should move on to the next child. At the end of the process, the sheets are handed in and a second sheet is taken. The teams then take a break (lunch). The whole process is then repeated after the break. Thus, without seeing the measurements they previously made, each enumerator measures each child twice.

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[37] The teams normally take longer during the pilot test than after they become used to working as a team.

[38] The supervisor's results can be taken as a "gold standard," or the mean of all the measurements can be taken as the gold standard. If there is a difference between the supervisor's data and the mean of the trainee's data, the exercise should be discussed and repeated.

At the end of the exercise the data forms should look something like those below:

Enumerator name………… ID ### 1st measure		
Child	Weight (kg)	Height (cm)
1	14.6	96.0
2	10.3	89.8
3	13.8	105.1
4	11.1	84.5
5	10.8	89.3
6	9.4	76.3
7	10.3	87.6
8	14.3	101.1
9	8.0	74.3
10	15.6	97.0

Enumerator name………… ID ### 2nd measure		
Child	Weight (Kg)	Height (cm)
1	14.8	96.1
2	10.4	89.5
3	13.8	105.3
4	11.0	84.7
5	10.7	89.0
6	9.4	76.4
7	10.3	87.6
8	14.1	101.2
9	8.1	74.1
10	15.4	97.5

The equipment used in the exercise should be the same equipment used to measure children in the survey itself. The team members will rotate but the equipment should not, so that each child is always measured with the same equipment (the team is being tested not the equipment). Only one pair of measurers should be with a child at any one time. Talking between pairs of trainee measurers during this exercise should not be allowed.

The supervisor observes each trainee's performance. He/she should check the positioning of the equipment, the adjustment to zero, the positioning of the child, the child's clothing, and the angle at which the reading is taken. The supervisor should make notes on any errors to be discussed with the team members later.

The results of the training exercise are analyzed by entering the data into the Nutrisurvey software and producing the training report.

If the results are poor, the whole exercise should be repeated, perhaps with different people paired in teams.

4.5.2 Field training

Field training is practical and not confined to the classroom. It takes place after the teams are able to make accurate and precise measurements, have "passed" the standardization test, and have formed teams that have practiced working together. For field testing the teams go to a convenient, local village that has *not* been chosen to contain a cluster. They practice selecting the houses that will form the cluster, approaching mothers and explaining the purpose of the survey, making the measurements, and conducting the mortality interview. This step is essential for the teams to feel confident when they begin conducting the actual survey.

The field training data from each of the teams is entered into Nutrisurvey and analyzed. The teams should each have selected different households from the village (otherwise it is likely that the selection was not random). Each team's results will be slightly different; this is used as a practical demonstration of the effect of sampling error and the importance of taking a random sample.

4.6 Nutritional measurements

4.6.1 Weighing equipment

The scale has to be light and robust. A suitable instrument for weighing children aged 6–59 months is a 25kg hanging spring scale marked out in increments of 0.1kg. Weighing pants should be provided with this scale. An electronic scale such as the Uniscale can also be used. Bathroom scales are not sufficiently accurate.

4.6.2 Equipment for measuring height and length

The measuring board should be at least 130cm long and made of hardwood with a hard water-resistant finish. Choice of wood is important; the boards should be light enough to easily carry from house to house and should not warp in the rainy season.[39] The board should have two tape measures attached to it, one on each side, and they should be marked out in 0.1cm increments. The foot-piece must be easily adjustable, remaining perpendicular to the board.[40] The board should be easily set upright to measure height; the head piece of the length board becomes the base when the board is set upright. It must be large enough for a child to stand on it and to stabilize the whole board when it is set

[39] Aluminum should *not* be used, because it can get very hot in the sun, and aluminum has a sufficiently high specific heat to burn children. The tapes should not be of metal for the same reason. A wooden board is most comfortable for the child. Rigid plastic boards are acceptable but expensive.
[40] It is best lubricated by rubbing with a candle.

upright. Measuring boards are usually made by local carpenters, but there should be at least one commercial board to be used as a carpenter's template to standardize the locally made boards. A height arch can be used for selecting children shorter than 110cm. This can be constructed simply and should consist of a horizontal bar fixed at 110cm above the ground at right angles to a vertical pole (or between two vertical poles). Any child who can walk under this horizontal bar without hitting it, and without stooping, should be included in the sample for further measuring.

All the boards are standardized with a broom handle or dowel that has been cut to measure exactly 100cm.

4.6.3 Estimating age

In many rural areas of the developing world, the age of children is not known. In general, the younger the child is, the more accurately you can estimate the month of birth. The following methods may be helpful if the mother does not know the child's birthday.

1. The mother may have the child's immunization card, road-to-health card, or other written document showing the child's age or date of birth. Always ask to see the child's immunization card.
2. If the age of a neighbor's child is known, ask whether their child was born before or after the selected child.
3. Use a "local-events calendar," which shows dates on which important events took place during the past five years. It can show local holidays, hailstorms, the opening of a nearby school or clinic and political elections, etc. Ask the mother whether the child was born before or after a certain event. In addition, the local calendar can include agricultural events that occur at the same time each year. These events can help identify which month the child was born in. Use of such a calendar can be time consuming.

In the context of emergency surveys, age is mainly used to determine whether the child should be included or excluded from the survey, and whether the sample has an equal number of children in each age category. It is not needed to calculate WFH.

4.6.3.1 Estimating age from height

Where the age is not available or reliable, and a local events calendar cannot be used to estimate the age of the children, then a height cutoff can be used for selecting children instead of age.

The height of normal children aged 6–59 months is approximately 65cm and 110cm respectively. Where age is not known, height can be used as a proxy measure. However, most populations where age is not known suffer from chronic malnutrition and the children are stunted. The less educated members of the community are more likely to have a stunted child and not know that child's age. This can result in a bias in the selection of children into the sample.

To partially address this problem, WHO recommends that in countries where the prevalence of stunting is known to be high, the height range should be changed to 65cm–100cm. However, this will also lead to a biased sample; height selection will include older stunted children and exclude younger but taller children. These inclusions and exclusions are unlikely to be representative of the children that would have been included or excluded if ages were known.

Of course, children selected using height (instead of age) criteria cannot be included in the HFA or WFA information. During data entry the age field is left empty so that the software can automatically exclude such children when assessing HFA and WFA. The percentage of children in the sample selected upon height instead of age criteria should be given in the report.

Unfortunately, there is no simple answer to the problem of unknown ages. It is likely that the estimates of stunting in many populations are inaccurate because of the problem of ascertaining age accurately. One particular difficulty is that different surveys—even ones in different regions of the same country or different population groups in the same area—will have a variable proportion of children selected to be included in the sample with an unknown age. This makes it difficult to properly compare surveys, although this problem is usually ignored when such comparisons are made.

One solution would be to select *all* the children that are to be included in a sample on the basis of their height. So that instead of having a survey of children aged 6–59 months, the survey would be of children 65cm–110cm. In stunted populations, this would result in having a different group of children included in the survey. However, the results from different surveys would then be comparable as the selection criteria would be consistent, clear, and unequivocal, and the team would not necessarily spend a lot of time trying to determine the children's age. This solution has not been accepted internationally.

4.6.4 Weight

Weight should be measured to the nearest 100 g (0.1kg). The scales should be checked for accuracy before and after each day's measurements, using the same known weights. Each team must use the same standard weights at the base. Standard weights do not need to be carried in the field, but the scale should measure the same in the morning and evening when the team returns from the field.

The scales should first be set at zero, with the weighing pants, basket, or basin attached.[41] Suitable standard weights include a commercial standard, a stone, or a perfectly sealed container filled with sand. Some agencies use the tins of oil distributed as relief. The standard weight should have the true weight clearly written on it, and the same weight should be used all the time. It is important *not* to use weights made from materials that will absorb water, dry out, collect dirt, spill, or change weight in any other way Sacks of food should not be used, as the nominal weight given on the bag is not sufficiently accurate.

Figure 4 shows the correct way to weigh child using a hanging spring balance and pants. There are several steps:

1. Explain to the child's mother what you are going to do.

[41] A plastic basin with four ropes attached to the rim is sometimes used. Some mothers do not like their child put into pants that have been on other children (there is a chance of fecal contamination and the spread of disease). The children are much more comfortable being weighed in such a basin, weighing is faster than with pants, and the basin can be easily washed. However, it is very inconvenient for the team to carry the basin from house to house and so is rarely used.

2. Hang the scale from a suitable point such as a tree, doorframe, or a stick held on the shoulders of two people (local men can be enlisted accompany the team to hold the scale). The dial on the scale must be at eye level.
3. Hang the weighing pants from the hook of the scale and check that the needle reads zero.
4. Remove the child's clothes and any jewelry, and place him or her in the weighing pants.
5. Hang the weighing pants, with the child in them, from the hook on the scale.
6. Check that nothing is touching the child or the pants.
7. Read the scale at eye level to the nearest 100 g (0.1kg).
8. Say the number out loud.
9. The assistant should repeat the weight out loud so that everyone can hear, and write the weight on the datasheet.

Always weigh the child before measuring the height. If there are two children in a household, ask the mother which child will be less fussy; weigh that child first as an example for the others who may be more frightened.

Often children will struggle, preventing the needle from stabilizing. When this happens, try to involve the mother and have her close to the child at all times. Get the mother to put the pants onto the child; be gentle and respectful; speak softly and do not shout or order the mother around. It is also a good idea to make sure that the team is wearing clothes with which the child is familiar, and it is usually better to have a female team.

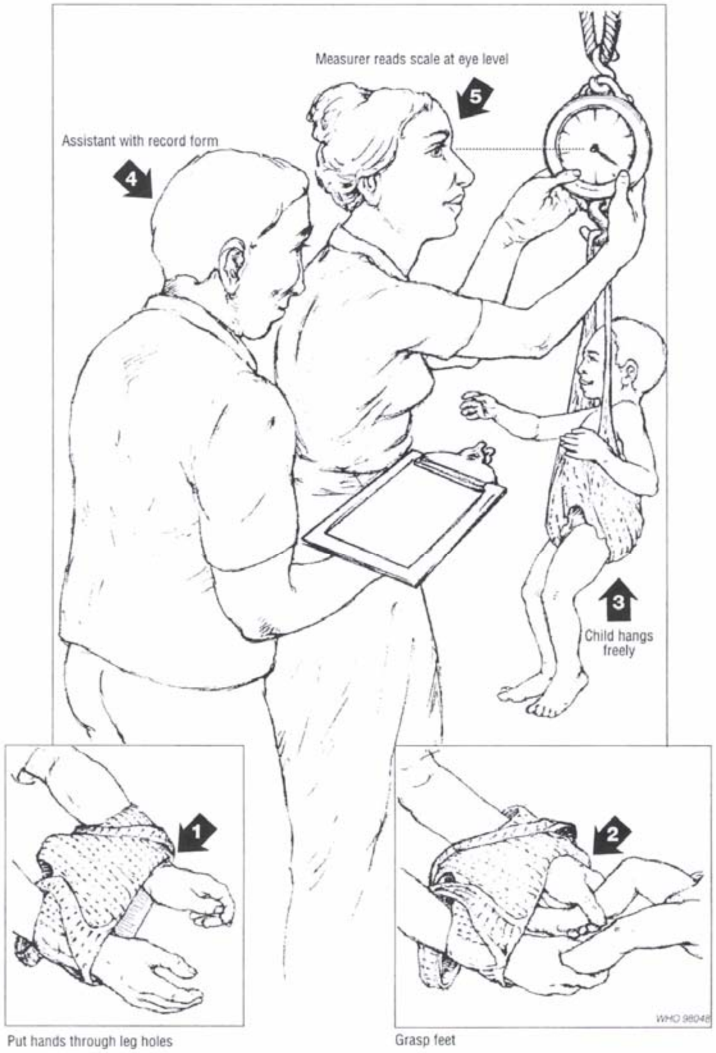
For the few children who may not stop struggling, estimate the weight by taking the value situated at the midpoint of the range of needle oscillations. Make a note that the weight may be inaccurate because of instability. This is normally done by circling the weight on the data sheet.

Older children may be able to hold on to a bar attached to the balance and lift themselves off the ground themselves.

In some societies, and in cold climates, it may not be appropriate or acceptable to take the children's clothes off. In these environments careful preparation before the survey should be conducted so that children can be weighed already clothed. This involves preparation and consideration of several things:

- A reference sheet of the weights and descriptions of popular items of children's clothing specific to the child's age and the season when the survey is being conducted.
- An album of photographs of different items of clothing, including a description of each item, its principle fabric, the age of the children wearing it and its weight.
- Careful training of the team to recognize the items accurately. If this process is well done, prior to analysis the weight of each child's clothing should be subtracted from the weight measured. This can yield an accurate estimate of the child's weight.
- If the clothes worn are fairly standard, e.g., a simple pair of pants, then a sample of the items can be weighed, and that weight subtracted from the weight of each child wearing similar pants. Such items usually weigh less than 30g, which is less than the

Fig. A3.1 Use of the hanging spring balance for weighing infants[1]



[1] Adapted, with permission, from *Assessing the nutritional status of young children: preliminary version.* New York, United Nations Department of Technical Co-operation for Development and Statistical Office, 1990.

Figure 4. How to weigh a child using hanging scales

100g increments of the scale. Nevertheless, such a weight must be subtracted from each child’s weight before analysis, because the “rounding” to the nearest whole scale division may have been affected by the pants.

The mother should not be interviewed for the mortality part of the survey while her children’s measurements are being taken. If this is attempted, it will be much more difficult to measure the children, and the mother will be distracted by the manipulation of her children, even if they do not cry. She will thus give less attention to providing full and accurate answers. Furthermore, if the team is too large, the mother and children are more likely to be intimidated or distracted.

4.6.5 Height and length

Children's height should be measured to the nearest 0.1cm. Children up to 85cm in height are measured lying down on a horizontal measuring board. Children above 85cm are measured standing up.[42]

Figure 5 shows how to measure the length of a child less than 85cm. There are several steps:

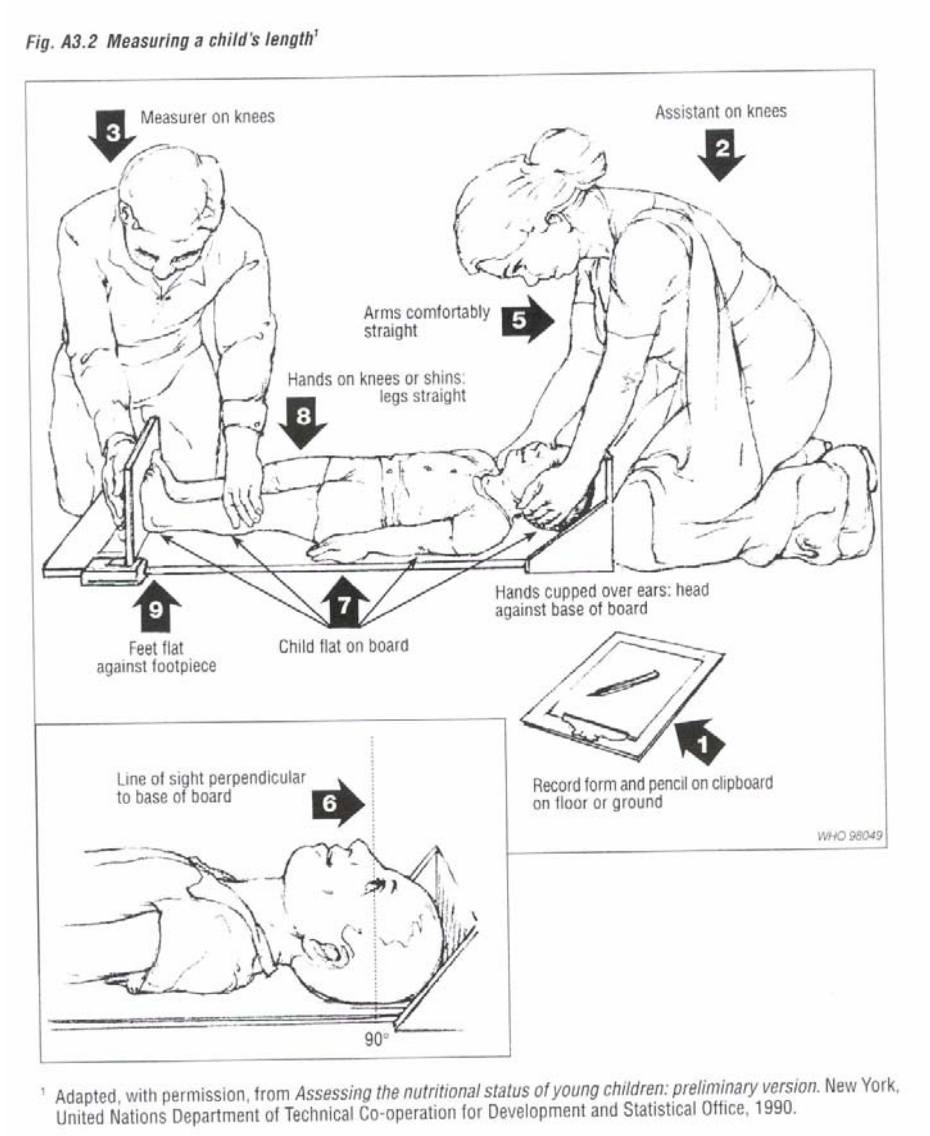


Figure 5. How to measure the length of a child less than or equal to 85cm

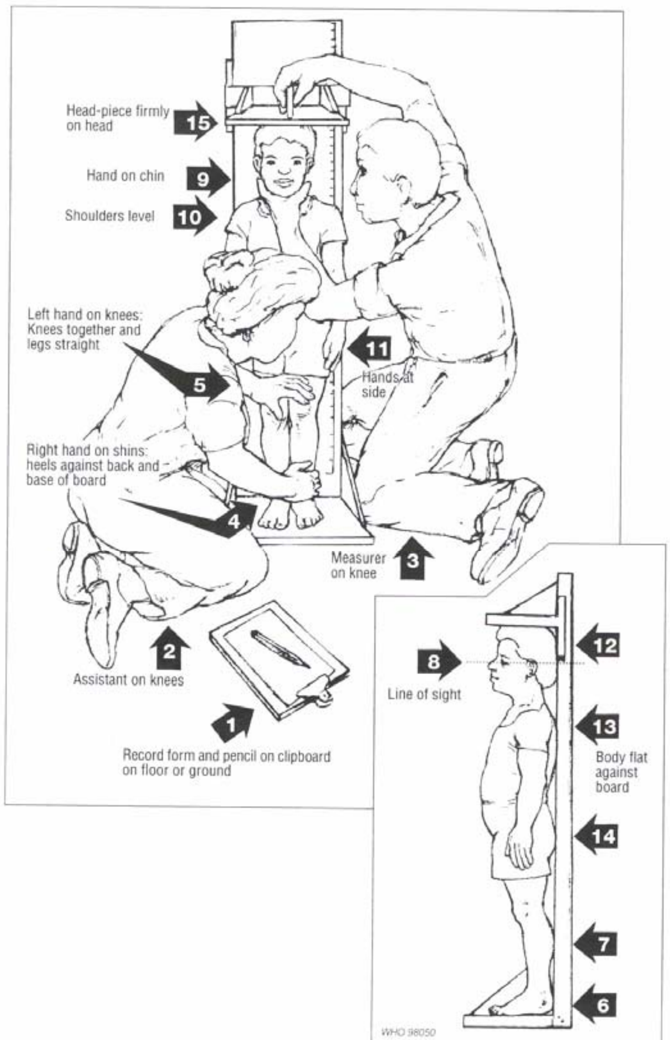
42 Some manuals suggest an age cutoff for taking length or height. This should never be used in an emergency survey. The cutoff is only based upon whether the child is above or below 85cm, no matter the age of the child.

1. Explain the procedure to the child's mother or caregiver.
2. Remove the child's shoes and any hair ornament or top knot on the top of the child's head.
3. Place the child gently onto the board on his/her back, with the head against the fixed vertical part and the soles of the feet near the cursor or moving part. The child should lie straight in the middle of the board, looking directly up.
4. The assistant should hold the child's head firmly against the base of the board.
5. The measurer places one hand on the knees (to keep the legs straight), places the child's feet flat against the cursor with the other hand, and pushes the cursor against the feet firmly but gently.
6. The measurer reads and announces the length to the nearest 0.1cm.
7. The assistant repeats the measurement out loud and records it on the datasheet.

In some cultures, parents may be unhappy about measuring a child lying down, as such a procedure is used to measure bodies for a coffin. In these populations, the measurement technique is at best seen as bad luck, and it is particularly important to have local people from the same culture as the main people on the team. It is also crucial that community leaders, religious authorities, and other influential people understand why the measurements are being made and give the teams explicit authority to make the length measurements. The mother must understand this and give her permission specifically. In these circumstances, children who can stand can have their height measured instead of length, and a correction made to the measurement.

Again, the height of a child is measured for children above 85cm. Figure 6 indicates how this is done.

Fig. A3.3 Measuring a child's height[1]



[1] Adapted, with permission, from *Assessing the nutritional status of young children: preliminary version*. New York, United Nations Department of Technical Co-operation for Development and Statistical Office, 1990.

Figure 6. How to measure the height of a child of more than 85cm

4.6.6 Edema

Edema is the retention of water in the tissues of the body. To diagnose edema, moderate finger pressure is applied just above the ankle on the inside of the leg were the shin bone is below the skin, or on the tops of the feet (figure 7). The pressure is kept for about three seconds. (If you count "one thousand and one, one thousand and two, one thousand and three" in English, pronouncing the words carefully, this takes about three seconds.) If there is edema, an impression remains for some time (at least a few seconds) where the

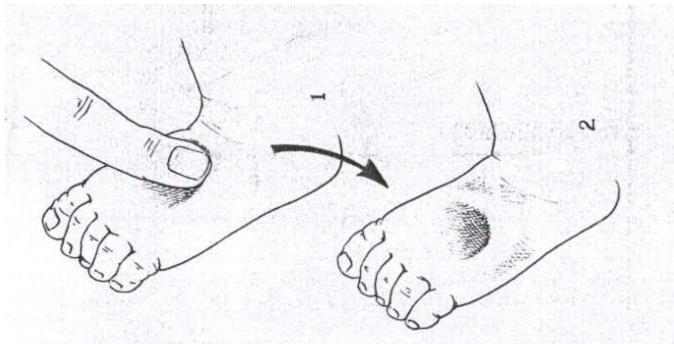


Figure 7. How to check for edema

edema fluid has been pressed out of the tissue. The child should only be recorded as edematous if both feet clearly have edema.

It can be quite painful if the enumerator presses hard on the skin. Hard pressure is *not* required to test for edema. The team should practice on each other and if anyone finds it painful or uncomfortable then the team member is pressing excessively. Edema should be tested for after weight and height/length are measured.

Most people, including doctors, overestimate the amount of edema in the body. Measurements of several thousand children losing weight during treatment for edematous malnutrition show that the average amount of edema is 3.6% of body weight. The Nutrisurvey software can automatically make an adjustment of 3.6% of body weight for any child that is recorded as having edema (set in the Options menu). Alternatively, the edema can be graded as absent, mild (+), moderate (+ +) or severe (+ + +):

+ mild: both feet/ankles

+ + moderate: both feet, plus lower legs, hands, or lower arms

+ + + severe: generalized edema including both feet, legs, hands, arms, and face

If the degree of edema is recorded (graded 0 to 3) then different adjustments are made by the Nutrisurvey software as indicated in table 7.[43]

Table 7. Percentage of body weight accounted for by nutritional edema

Degree	**Edema as % body weight**	**Correction factor applied**
No edema	0.00	weight * 1.0000
Mild (+)	2.68	weight * 0.9732
Moderate (+ +)	4.31	weight * 0.9569
Severe (+ + +)	8.38	weight * 0.9162
Weighted mean	3.60	weight * 0.964

[43] M.H. Golden, The Clinical Assessment of Oedema: Implications for Feeding the Malnourished Child, *European Journal of Clinical Nurition* 43 (1989): 581–82; Y. Grellety, Management of Severe Malnutrition in Africa (PhD Thesis, University of Aberdeen, Scotland, 2000).

4.7 Mortality interview

To estimate a mortality rate from a survey, we need to know the total number of people at risk and the length of time over which they were at risk. However, the composition of some of the households will have changed during the recall period (due to death, birth, migration into and out of the household); thus, the number of people within each household will not have been constant during the recall period.

Figure 8 diagrams an example recall period. At the beginning of the recall period, the household had three members, and at the end of the recall period the household also had three members but only one person was in the household during the entire interval. At one time, the household had six members. In calculating a denominator for this household, two main methods have been used: "past household census" and "current household census."[44] In both methods, a household census is taken at the beginning of the recall period or at the present time, respectively, and the changes that have occurred during the recall period are explored. In this manual we recommend a modification that takes account of people joining or leaving the household during the recall period.

In an emergency, it is likely that people will both leave and join households at an increased rate. If the in-migration and out-migration are significantly different from each other, this will have an effect upon the calculated death rates.

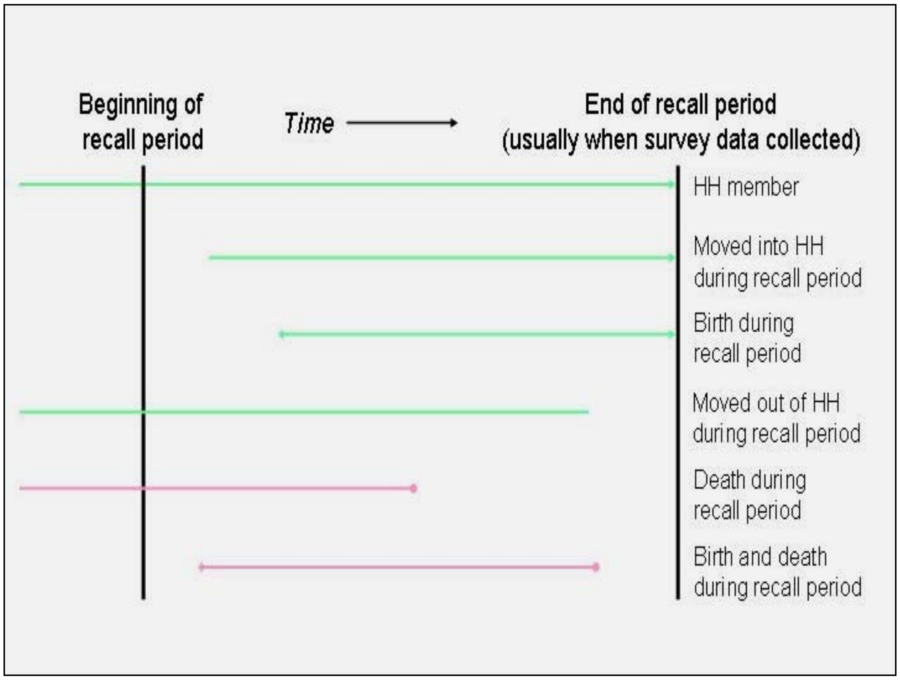


Figure 8. Household members experience during the recall period

[44] The past household census method counts persons present at the start of the recall period, births, and deaths. It includes out-migrants, counting them as if they were present for the whole of the recall period, and excludes in-migrants. The current household census method counts persons present at the time of the survey, births, and deaths. It includes in-migrants, counting them as if they were present for the whole recall period, and excludes out-migrants.

To calculate the denominator (the number of people and lengths of time at risk) the respondent is asked

1. to list all the household members at the time of the survey[45]
2. whether each of these household members were present at the start of the recall period
3. to add to the list all members of the household that were present at the start of the recall period but have left the household during the recall period[46]
4. whether the individual is above or below age 5 (to derive 0–5DR)
5. whether young children were born during the recall period
6. to list all deaths that occurred in the household during the recall period

Two additional questions are usually asked:

7. the age of each member (to confirm if an individual is above or below age 5 and allow a demographic pyramid of the population to be constructed)
8. the sex of each member (only necessary if sex-specific death rates are required)

Two additional optional questions are sometimes asked:[47]

9. the date of any death (usually unreliable)
10. the cause of death (often unreliable)

These data are collected on a form, using a separate sheet for each household. An example of the form is given in figure 9. An example of a more complete form that contains the additional information is given in appendix 2.

The CDR is then calculated by Nutrisurvey. It is assumed that those who were not present in the household for the whole of the recall period (those who left and those who joined the household) were present on average for half the recall period.[48]

Thus, the "Total Population" Nutrisurvey uses is the sum of

+ *all* those present in the household at the time of the survey
+ *half* the deaths
+ *half* those present at the beginning of the recall period but who had left by the time of the survey

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[45] This is the same as the current household census method. Sometimes the respondent is simply asked to state how many people are in the household. Although this is quicker, it is much less accurate than asking the respondent to list all household members. We recommend that the household members be enumerated.

[46] This is not part of the current household method but is added here to account for out-migration.

[47] Where there have been an unusual number of deaths due to a single event, such as a natural disaster or a violent attack, it is inappropriate to calculate a death rate (deaths per unit time) to estimate the effect that happened at a single point in time. In these circumstances, deaths at the time of the event or shortly thereafter (the time interval needs to be defined) are recorded and expressed as a proportion of the population that died associated specifically with the event itself. It is also very important to record whether the death was directly due to the disaster/war/violence. When examining such an episode, we *also* want to estimate the CDR and 0–5DR before and after the event as well as the proportion who died during the event.

[48] Note that the denominator is actually *person x days*. It is mathematically equivalent to count half a person as it is to count half the recall period for that person.

Survey district:_Ambo________Village:_Limbo_____________Cluster number:_4_____
HH number:____23 _________
Date:__12- Aug - 04_________________Team number:__2___________

	1	2	3	4	5	6	7
ID	HH member	Present now	Present at beginning of recall (include those not present now and indicate which members were not present at the start of the recall period)	Sex	Date of birth/or age in years	Born during recall period?	Died during the recall period
1	Mother (respondent)	√	√	F	Adult		
2	Father	√	√	M	Adlt		
3	Uncle 1	√	√	M	Adutl		
4	Aunt 1	√	√	F	Ad		
5	Aunt 2	√	x	F	Ad		
6	Child 2	√	√	F	12		
7	Child 3	√	√	M	8		
8	Child 4	√	birth	M	2/12	√	
9	Child 1 aunt 1	√	√	F	4		
10	Child 2 aunt 1	√	√	M	1		
11	Child 1 aunt 2	√	x	M	3		
12	Grandmother	Dead	√	F	A		√
13	Grandfather	x	√	M	A		
14	Child 1	x	√	M	over 5		
15	Uncle 2	x	√	M	A		
16							
17							
18							
19							
20							

Tally (these data are entered into Nutrisurvey for each household):

Current HH members – total	11	Ticks col 2
Current HH members - < 5	4	
Current HH members who arrived during recall (exclude births)	2	X's col 3
Current HH members who arrived during recall - <5	1	
Past HH members who left during recall (exclude deaths)	3	X's col 2
Past HH members who left during recall - < 5	0	
Births during recall	1	birth col 3 and 6
Total deaths	1	Dead col 2 and 7
Deaths < 5	0	

Figure 9. Example of household enumeration data collection form

- *half* those present at the time of the survey but who joined the household during the recall period.[49]
- *subtract:* **half** the births

[49] If in- and out-migration are exactly balanced, counting half a person for each migrant is the same mathematically as counting all in-migrants as whole persons and ignoring out-migrants in the current-household method. It is also the same as counting out-migrants as whole people and ignoring in-migrants in the past-household method. However, both in- and out-migration are frequently major coping strategies in a disaster situation, and one is usually far greater than the other and will influence the final result. Therefore, we suggest attempting to enumerate both in- and out-migration in an emergency survey. This is a bit like combining the current and past household census methods together. Furthermore, in- and out-migration rates can be easily calculated from the data and are useful to include in the survey report.

Infants that were born and died within the recall period are counted as deaths but are not included in the denominator. The calculations are done automatically by Nutrisurvey.

4.7.1 Mass migration

In an emergency situation whole families migrate. There are likely to be whole families that arrive in the survey area during the recall period. Part of their experience will have been in the study area, and part in the area from which they migrated. In the case of a forming refugee/IDP camp, this can apply to a large proportion of the study population. The mortality experience in the camp itself is likely to be very different from that experienced before they departed from a stricken area or on the journey, which is usually particularly hazardous. The various households will have arrived at different times. Under these circumstances, if we take a fixed recall period, some of the respondent households will have been in the camp for the whole period and some will be new arrivals that have spent most of the recall period elsewhere or on the journey.

In a camp situation, it is desirable to derive separate death rates for the time that the population was in the camp and for the time before the displaced households reached the camp. As the denominator for the death rate is person-days at risk, if we know how long each household has been in the camp, we can calculate a death rate, but in this case the recall period (or "period considered at risk") is different for each household. The date of arrival can often be determined from a registration card given to new arrivals. Arrival is also an important date that most migrating households remember. In this case, the date of arrival is recorded for each household, and the time period used in the equation is the average number of days each household has spent in the camp.

To derive the separate mortality rate for the time before arrival, the fixed recall period is used, as in the standard method, and the average time spent in the camp subtracted from this time. Deaths are recorded as occurring in the camp or before arrival but after the start of the recall period. The "before arrival" mortality rate is much more susceptible to serious sampling error, because the households are self-selected in terms of those that have the means, opportunity, and composition that enable them to migrate, and the households may have arrived from a wide variety of different geographical areas. The rate thus only applies to the migrants who have reached the camp and should not be extrapolated to the area of origin.

It is much more difficult to calculate the sample size needed to separate CDR into two components—before and after arrival. There is an added variable in the calculation: the average length of time households have spent in the camp. In effect it is like doing two surveys using the same households: one for the time in the camp and one for the time before arrival. If the average length of time in the camp can be obtained from the camp's administrators, this is used as one of the "recall periods" in the calculation.

4.7.2 Determining cause of death

Inquiry into cause of death should be limited to causes that are clearly defined by local terms and familiar to the local population. These include measles, neonatal tetanus, and diarrhea. If local terms do not exist, inquiry should be limited to deaths due to violence and all other causes. Violent deaths can be due to war injuries and atrocities, or accidents not related directly to conflict. In this case two questions are sufficient:

1. "Did [the person] die from some sort of violence such as being assaulted, shot or violated, a car accident, fall, drowning, poisoning, burn, bite or sting?"
   If YES, Go to next question.
   If NO, record death not related to injury or violence.

2. "Was this injury caused by someone fighting the war such as from a bullet, bomb, mine, machete or assault?"
   If NO, record non-war-related injury or violence as cause of death.
   If YES, record war-related injury or violence as cause of death.

As with other parts of the household questionnaire, questions about cause of death need to be translated into the local language, back-translated to the original language to ensure accurate translation, and pretested in the local setting. Usually the head of household is interviewed; however, there may be a need to interview multiple respondents if the current head is a child or a relative who has lived only part of the recall period in the household.

4.8 Analysis of results

The report should always be presented in a standard format and contain all the information that allows the reader to understand why the survey was conducted, the methods used, the population to which the results apply, the results themselves, any additional relevant information, and a summary of problems encountered. The report can also contain recommendations. These recommendations should not be simply general recommendations, but should be directly supported and justified by the data in the report. The presentation of the information in a standard way ensures that no important information is omitted. It also allows a reader who is familiar with the format to quickly find the particular information he or she is looking for. The Nutrisurvey software takes the data that have been entered during the survey, does the analysis, and presents the data in a standard format. It also gives headings of all the paragraphs that need to be completed by the person responsible for the report.

5 Using Nutrisurvey software, step-by-step

A SMART survey is designed to be analyzed by computer using the Nutrisurvey software. It can be downloaded free from either www.smartindicators.org or from www.nutrisurvey.de/ena/ena.html. The food security component is analyzed using a separate Excel spreadsheet that is not yet included in the software.

The analysis can also be done using other programs or by hand, although this is not recommended for non-epidemiologists.

The first screen of the Nutrisurvey software program is the anthropometry data entry screen.

The various sheets on the front-end are used in order.[50] The steps for using Nutrisurvey are as follows:

1. Planning the survey.
2. Training the teams.
3. Entering the nutritional (anthropometric and edema) data.
4. Entering the mortality data.
5. Checking the data for errors and plausibility.[51]
    a. Highlighting implausible values.
    b. Analysis for digit preference.
    c. Analysis by team.
    d. Comparison of the prevalence of severe malnutrition calculated from the mean and standard deviation with the prevalence from counting the subjects below the cutoff points.
6. Generating the results.
7. Writing the report using a standard format.

5.1 Planning the survey

Figure 10 shows the Nutrisurvey survey planning screen. The survey must be given a unique name (see the section on "Naming of files" below).

The software cannot help decide what type of sampling will be conducted.

1. The survey will either be a random sample (simple random or systematic random) or a cluster survey. Check the appropriate box.

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[50] As the software is under continuous development, the version downloaded may not be exactly the same as that shown here. The "update" notes that are downloaded with the software should be consulted for a full description of the current version.

[51] In future versions, the distribution of the data will also be examined.

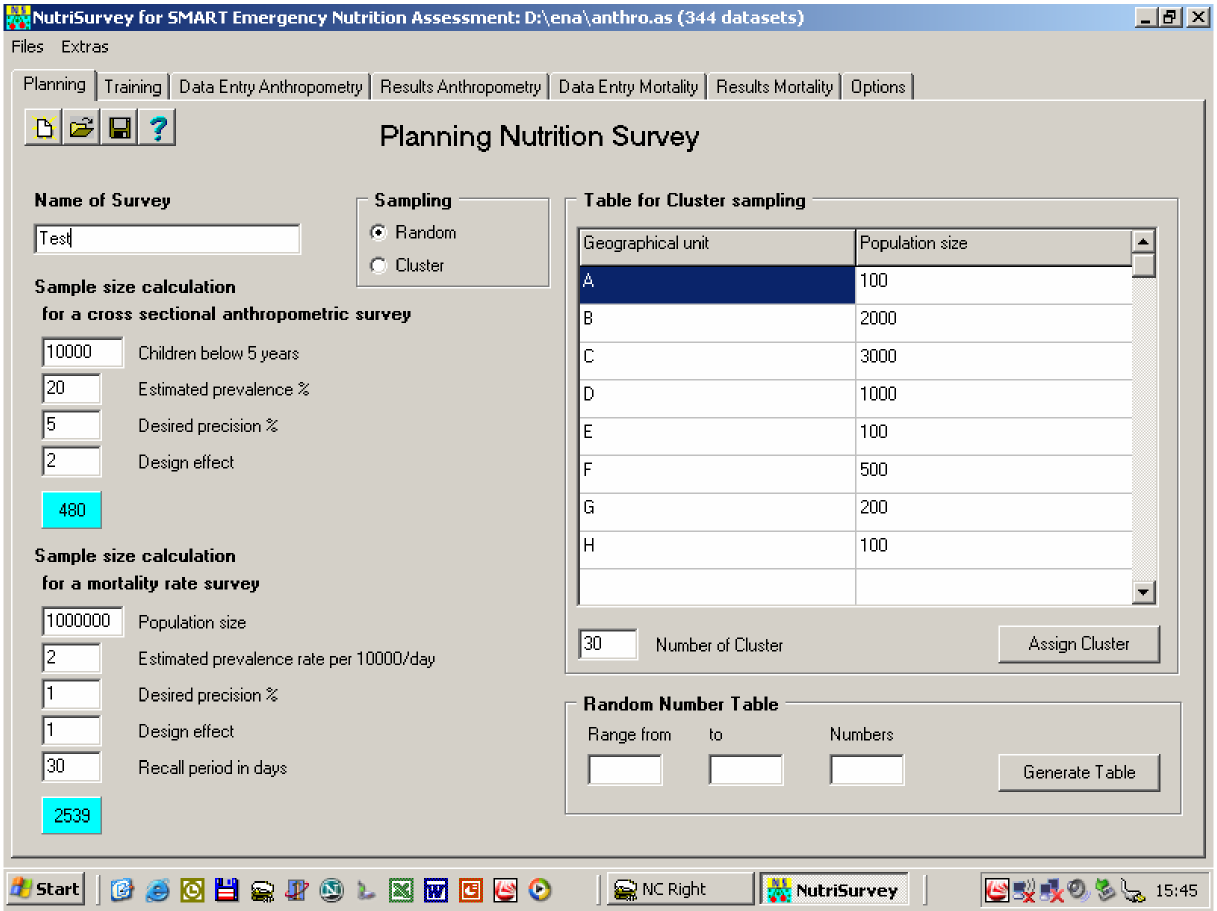


Figure 10. The design screen of the Nutrisurvey software

For the *anthropometric component of the survey:*

2. Enter an estimate of the total population targeted by the survey. The population number for nutrition needs to be the population of children under age 5.

3. Enter the estimated prevalence. If you are uncertain, enter the highest (maximum) prevalence you expect from a range of likely values. However, if you are particularly interested in a particular prevalence (for example, the level that would trigger an emergency response), and you suspect the actual prevalence is below this threshold, enter the threshold number.

4. Enter the widest confidence interval you can tolerate in the estimate (normally 5% or more at high rates of prevalence, falling to about 2.5% for lower rates). This figure has a substantial effect upon the number needed for the sample.

5. Enter the design effect. The default design effect for sample size calculations for malnutrition is 2.0. However, a design effect of 1.5 for malnutrition in children is

often sufficient. The decision should be made individually for each emergency context.[52]

The results of steps 1–5 yield the total number of children required for the sample (sample size). This figure will be automatically calculated and will appear in the blue box. In cluster surveys, this number should be divided by the number of households that can be visited each day. This will provide the number of clusters.

For the *mortality component of the survey:*

1. Enter an estimate of the total population targeted by the survey. The population number for mortality needs to be the total population.
2. Enter the expected mortality rate (/10,000 persons/day).
3. Enter the required precision (/10,000 persons/day). For example, if your expected mortality rate is 2.0/10,000 persons/day and you want a confidence interval of 1.4–2.6, enter a required precision of 0.6 (i.e., 2.0 ± 0.6 = 1.4–2.6). The precision chosen has a substantial effect upon the sample size needed.
4. Enter the design effect. The default design effect for sample size calculations for mortality is 2.0. If violence-related-mortality is limited, a design effect of 1.5 for crude death rate may also be sufficient.
5. Enter the chosen recall period in days. In most situations, a recall period of approximately 90 days (or between 30 to 120) days will be used. However, the decision should be made individually for each emergency context. This will depend upon the time of a "memorable event," and this is rarely exactly 90 days. The recall period also has a substantial effect upon the number of households that will need to be interviewed.
6. Divide the sample number by the average household size. This will give the number of households that should be visited to achieve the sample size.

5.1.1 Choosing the clusters

5.1.1.1 Enter the number of clusters

There should always be at least 30 clusters. Twenty-six clusters is the minimum for the survey to be valid. The best way to obtain the number of clusters is to decide realistically the number of households that can be visited in one day. The higher of the two values, (a) the total sample size of children (assuming an average of one eligible child per household visited), or (b) the total households needed for the mortality survey, is divided by the number of households that can be visited in one day. This is the number of clusters that should be chosen if it is equal to or more than 30. Otherwise, 30 clusters should be used. If there is a choice, it is better to increase the number of clusters and reduce the numbers of children in each cluster.

[52] Research is presently underway to examine the distribution of design effects in well-conducted surveys. The range of design effects that are often found under different circumstances will be included in later versions of the SMART methodology.

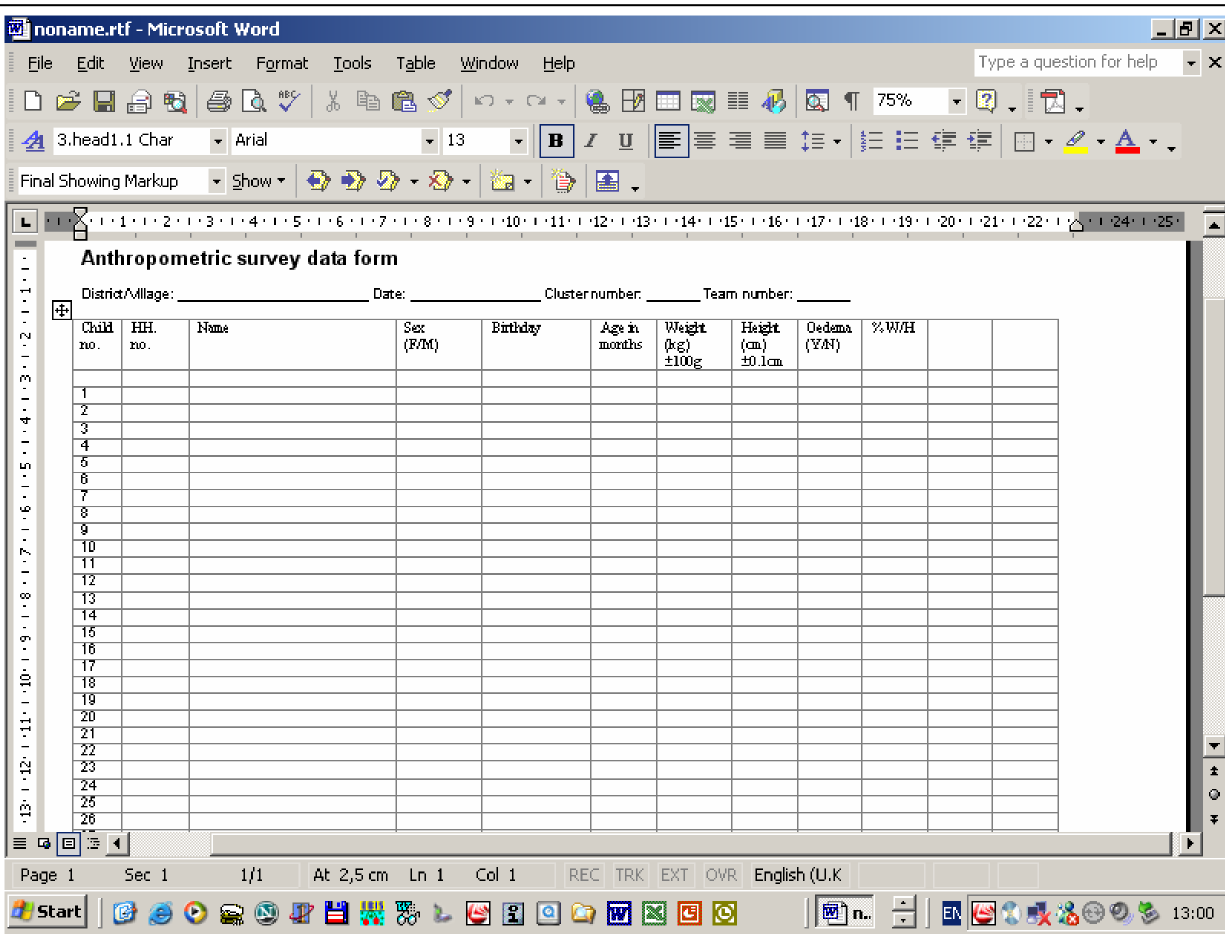
5.1.1.2 Choose the clusters

Enter the names of all the villages, towns, subdistricts, or other areas that will potentially be chosen to include in a cluster. All potential areas have to be entered. It does not matter what order the areas are entered. If they are omitted at this step, they are not part of the surveyed population. Enter the estimated population size for each "village."

The computer will then select the areas where there will be clusters. This is calculated at random, with the chance of any village being chosen being proportional to its population. This should be done only once. Once the cluster sites have been chosen, this is fixed. It will potentially introduce a bias if they are reselected. Under no circumstances should the program be rerun several times until particular villages are included or excluded.

5.1.2 Field recording

The anthropometric data are entered on datasheets as they are taken (figure 11). These sheets are included in the software in Microsoft Word format for printing. One data sheet is used for each cluster.



Anthropometric survey data form

District/Village: ______________________ Date: ______________ Cluster number: ______ Team number: ______

Child no.	HH. no.	Name	Sex (F/M)	Birthday	Age in months	Weight (kg) ±100g	Height (cm) ±0.1cm	Oedema (Y/N)	%W/H		
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
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Figure 11. Anthropometric survey data form

In most surveys it is not necessary to enter the child's name if the child is at home and the measurements are complete. This only takes additional time for the team to record and the data are not used. Names *are* entered for eligible children who are absent from the house when it is visited. This enables the team to ask for the specific child when they return to the house at the end of the day. A household number has to be assigned to each house even if it has no eligible children. They are recorded at the end of the sheet and given consecutive household numbers starting with 31 and recorded as having no children. The same household number is used for the mortality data form. The WHM (% WFH) is *not* calculated for each child on the datasheet in the field. The reason for having this column is for children who are going to be referred to a feeding center or other facility. The last columns are used for notes or other data that are to be collected for each child (e.g., MUAC).

5.1.3 Data entry

The data is entered into the computer using the Nutrisurvey software. The entry panel is shown in figure 12.

The survey date, cluster number and team number are entered in the first row (the village that has been chosen for the cluster is already in the database in the planning stage—the same cluster number should be used in this panel). As the data are entered these fields will default to the last entered information so that the data do not have to be entered for each subject.

The identification number will increment automatically by one for each new record that is entered.

The household number will not be incremented, as there is often more than one child in the same house. The household number needs to be entered. These must be the *same* household numbers as those used for entering mortality data.

Enter either the age in months or the birth date in the age fields. If the birth date is entered, the age is automatically calculated. If age is entered the birth date field is left blank. It is not necessary to enter an age to proceed. If age is not entered, it is assumed the child was selected on the basis of height and that the age is not known with sufficient accuracy to be recorded. In this case, WFA and HFA will not be calculated or entered into the database.

The anthropometric variables are automatically calculated as data are entered. If there appears to be an error in the data, the field will turn red. The cutoff points to alert the person entering the data can be set in the options screen.

In the plausibility report, the program will list and query any value that is ± three standard deviations of the survey mean. After one or two clusters have been entered, or if there has been a previous survey, it is useful to enter in the variable view sheet the limits as the mean ± three standard deviations (or 3 z-scores) during data entry. This enables potential errors to be picked up as early as possible during data entry.

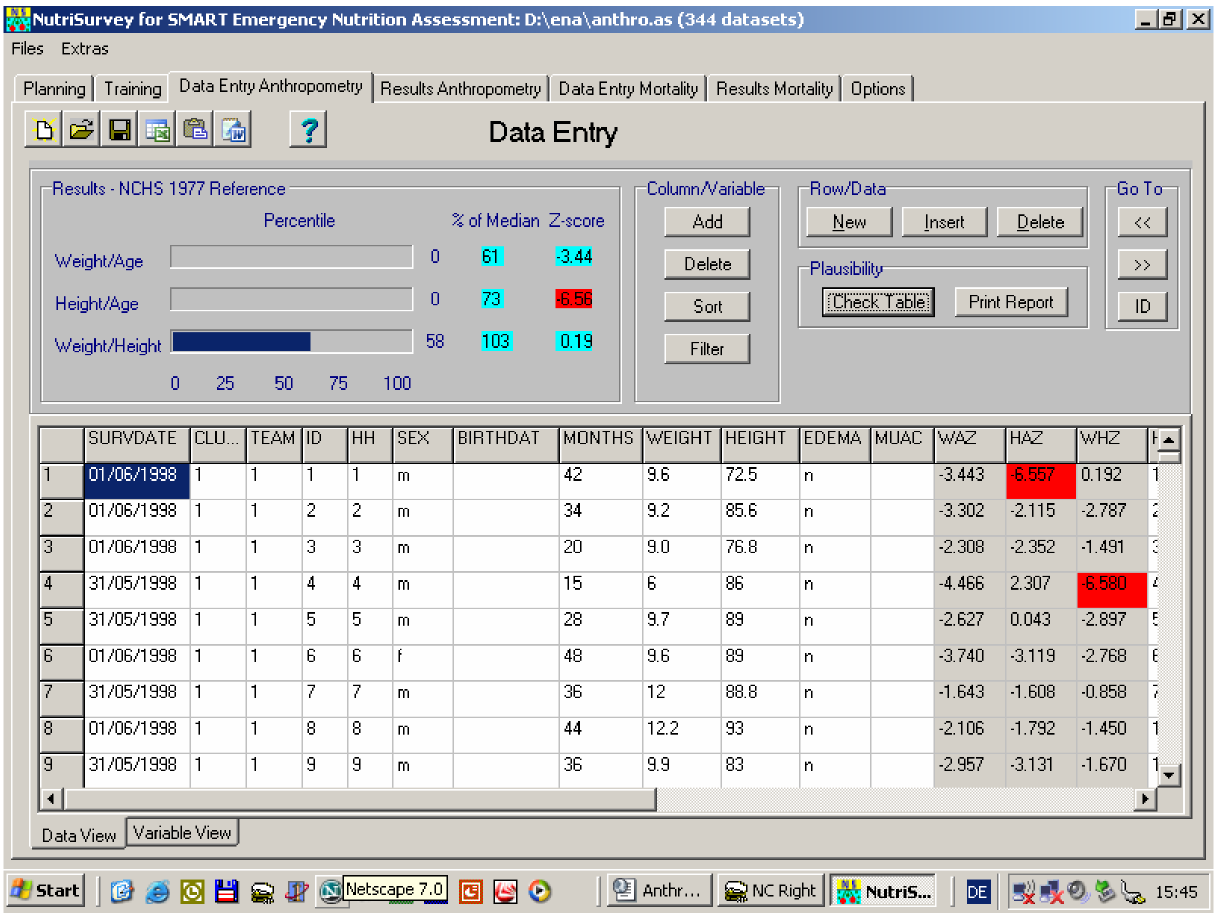


Figure 12. The Nutrisurvey entry interface

It is useful to enter the data into the computer when the team gets back to base, or even in the field using sub-notebooks with long battery life if these are available (software for Pocket PCs that is directly linked to Nutrisurvey is currently under development). This will facilitate a return to the household (while the team is still in the area) to retake the measurements.

If the edema field is not entered, it defaults to edema being absent during analysis.

5.1.4 Naming of files

It is important to be consistent in naming files and directories and to give all files names that can be recognized later by any member of the team. All the files relating to a particular survey should be put into a separate directory.

The name of the file should start with a three letter code for the country (e.g., SUD for Sudan, ZAM for Zambia, ANG for Angola, etc.), then the file-name should have the date of the survey in YYMM format (year, year, month, month). In certain circumstances the region, type of subject (refugee, IDP, resident), or the agency involved can be usefully included in the name of all the files. Then there is a code for the type of file: REP for report, DAT for the data file, etc.

This naming convention means that if the files in the directory are sorted they will automatically be listed in a clear order and all the files pertaining to a particular survey will be together. All files related to one survey should be kept in a unique directory. The directory should also be named using the same convention (by country and date), and any other information that makes the directory unique for a particular survey. It is important that everyone in an agency uses the standard convention for naming files.

Thus, a file named <LIB_0408_rep.doc> would be the report of a survey taken in August 2004 in Liberia. There may be several simultaneous surveys conducted in Liberia around that time, <LIB_0409_IDP_Buchanan_AAH_dat.xls> would be the data file for a survey with IDPs in Buchanan, Liberia in September 2004 conducted by Action Against Hunger. Under no circumstances should the files be called "report.doc" or "SupervisorsName.doc."

5.1.5 Data preparation and cleaning

Before doing the definitive analysis, any errors in the data need to be identified and, if possible, corrected. This is done partly during data entry. An implausible or "out-of-range" value is colored red during data entry. The ranges should be set in the variable view sheet before data entry.

Data cleaning is also done using Nutrisurvey's "plausibility" check. The computer automatically examines the data to see if there are values outside the usual or expected range and lists them in Microsoft Word. These values should be reviewed and checked against the original written data collection sheets. Any error in data entry should be corrected immediately.

5.1.5.1 Missing data

If certain critical pieces of information are missing from a child's survey record, it will not be possible to include the child in some of the anthropometric data analyses:

Age: If information on age is missing, you can still include the child in the assessment of wasting and edema, because these do not require age. However, you will need to be sure the child is eligible to be in the survey (i.e., in the required height range of 65cm–110cm).

Sex: If information on sex is missing you should still include the child in the assessment of wasting and edema. The reference population information on height and weight is sex specific. However, the difference between the sexes in terms of the WFH reference standards is small, and irrelevant for edema.

Height: If information on height is missing you *cannot* include the child in the assessment of wasting. However, the child can still be included in an analysis of edema, because any child with edema is severely malnourished.

Weight: If information on weight is missing you *cannot* include the child in the assessment of wasting. However, the child can still be included in an analysis of edema.

5.1.5.2 Data outside the required range

In most nutrition surveys, we are measuring children aged 6–59 months, *or* children who are 65cm–110cm tall. Children outside these ranges should not be included in the results. These values depend upon the defaults that have been set in the variable view sheet of the software. The *default is to accept any child who is in the correct age range,* even if the height is out of range. Any child outside the age range will be marked by the program. If height data are missing, the anthropometric indices of interest cannot be calculated. However, if the age is within range, the child can be included if there is edema. The accepted height range can be altered in the variable view sheet, for example, to change the range to 60cm–100cm if the population is very stunted. These choices must be included in the report.

Thus, by default, if a child is 55 months old and 112cm the child will be included. However, if the child is 65 months old, it should not be included and the computer will automatically exclude the child in the results.

5.1.5.3 Extreme WFH data

In addition to excluding children with missing information, or who are out of the required range, we also want to exclude children who have a WFH that is more likely to be the result of an error than a true measurement. There are various ways of doing this. Clearly, data that are biologically unlikely are very likely to be the result of a measurement or recording error. Thus, it is very unusual in an emergency context to find any child with a WHZ < –5.00 or a WHZ > +3.00.

Most children with wrongly measured data give values that are within the plausible range. Inclusion of such errors can be surmised from examination of the standard deviation, and other statistical checks on the data. The standard deviation should be between 0.8 and 1.2 z-score units for WFH in all well-conducted surveys (in 80% of surveys the standard deviation is between 0.9 and 1.1 z-score units). The standard deviation increases as the proportion of erroneous results in the dataset increases; this has a very dramatic effect upon the computed prevalence of wasting. For this reason, if a value is more likely to be an error than a real measurement, it should be removed from the analysis. We do this by taking the mean of the WFH data as the fixed point for describing the status of the population we are surveying. Statistically about 2.5 children out of 900 will lie outside the limits of ±3 z-score units of the mean. Less than 0.5 out of 1,000 will lie outside ±3.5 z-score units from the mean. This forms the basis for deciding if a value is more likely to be an error than a real measurement. The software will list children with these extreme values in the plausibility check list.

5.1.5.4 Checking for measurement bias

Measurement bias occurs when the team has not been adequately trained or supervised or when the measuring equipment is faulty. The best way to avoid measurement bias is to be rigorous in training and supervision and put in place careful checks to assure the quality of the equipment. Supervisors should check data collection forms at the end of each day to see if WHZ are feasible and within the plausibility range, and to see if edema is being realistically reported.

There are several useful methods to check the quality of the anthropometric data collected during a nutrition assessment after the data has been collected:

First, the distribution of the final decimal for height and weight. This will tell you if the team members are rounding weights and height to the nearest kilogram or centimeter, respectively. This phenomenon is called “digit preference.” Nutrisurvey automatically examines the data for digit preference. Furthermore, it examines the digit preference for each of the teams. There may be one team that is “cutting corners” or has been improperly trained or supervised. The data can then be examined to see if there is a substantial difference if the data from that team is omitted.

Second, the standard deviation of the z-scores for WFH and HFA should be examined. As explained in the section on extreme values, this tells you if there is substantial random error in the measurements. If the standard deviation is high (over 1.2), it is likely that there are a lot of extreme values and values more than ±3 z-scores of the mean. Nutrisurvey not only examines the standard deviation for the whole survey, but it also calculates the standard deviation for each team’s measurements and the number of extreme values for each team. The standard deviation and prevalence of malnutrition can then be examined omitting the data from one team. Comparison of the data with and without that particular team’s results should be undertaken to see if there is a substantial difference. Any problems should be reported.

There are other statistical measures that are computed on the data and for each team’s results. First is skewness, which measures the extent to which the results are symmetrical. The “moment of skewness” should lie between 1 and –1. Similarly, kurtosis measures whether the tails are very long (Mexican hat) or very short (pudding shaped), with too many values in the shoulders of the distribution. The “moment of kurtosis” should also lie between 1 and –1. These variables can also be computed for each team, and with one team omitted. It is extremely difficult to fabricate data for weight and height that “pass” all these checks for data distribution. In particular, the kurtosis checks whether values that might be considered to be an error by the team have been removed (sometimes referred to as “overcleaning”). If any of the distribution checks are abnormal, the survey may be biased and the results unreliable.

There is a further check that can be made with a cluster survey. If the number of individuals with wasting in each cluster is calculated, there will be one number for each cluster. These numbers should follow a statistical distribution called a Poisson distribution. The program tests whether the numbers follow this distribution statistically. If the distribution is not Poisson, it means the population forming the sample is heterogeneous, with “pockets of malnutrition” and areas that are spared. These problems are often caused by the design of the survey, nonrandom selection of the villages to contain the clusters, biased selection of houses in some areas, or excessive heterogeneity in the surveyed population. The Nutrisurvey software automatically calculates the Poisson distribution for wasting and compares this with the expected distribution. If the data do not follow a Poisson distribution, there will also be a larger than usual design effect. These two statistics give complementary information.

When we examine many surveys, we find that the clusters with edema do not follow a Poisson distribution, as they should if the whole population were equally vulnerable. In fact, edema follows what is called a “negative binomial” distribution, which means that there are some villages where lots of children get edema and others that are relatively protected. This design effect for edema is usually larger than for wasting, and this complicates calculation of the confidence intervals for severe malnutrition.

If there is no substantial digit preference, the standard deviation is between 0.8 and 1.2, the moments of skewness and kurtosis are within the range of 1 to –1, and the distribution of wasting follows a Poisson distribution, then one can be reasonably confident that the survey has been properly conducted, the sampling method is a fair representation of the population, and the results can be relied upon.

Even if there is no immediate intervention expected to address stunting, calculating the HFA z-scores and their standard distribution should also be examined. The most usual reason for a problem with the HFA data is determination of age.

Once the data have been cleaned and examined to ensure they are plausible, we proceed to the final analysis.

5.1.6 Analysis and reporting

The graphs of the distribution of the combined variables, by gender, should be examined. The data are automatically analyzed and reported as a Microsoft Word file. The headings are generated. The survey supervisor should go through each heading and enter the relevant information. The quantitative data are presented in the tables.

To put the illustrations into the report, the graphs are transferred to the clipboard within Nutrisurvey and pasted into the report at the appropriate place.

6 Food security (optional component)

6.1 *Interpreting nutrition surveys: conducting a food security assessment*

6.1.1 Why is a food security assessment needed?

Anthropometric surveys estimate the prevalence of malnutrition at the time the survey was done: they give no indication of whether the findings are abnormal or how the rate of malnutrition is likely to evolve, without which it is impossible to plan a response. This chapter provides basic conceptual and practical guidelines necessary to conduct a simple food security assessment and to help interpret nutritional data.

Most nutrition surveys use WFH as a proxy indicator of people's recent food intake. The aim of a food security assessment is to understand what has happened to people's access to food, and by implication their food intake, and how this should relate to their nutritional status.

6.1.2 The problem of interpreting nutrition survey findings

Figure 14 shows how nutritional status varies between different years, and within years at different seasons, even in relatively normal times in one part of Ethiopia. The figure shows that there is substantial seasonal variation in nutrition status within each year, and variation between years, even at the same season.

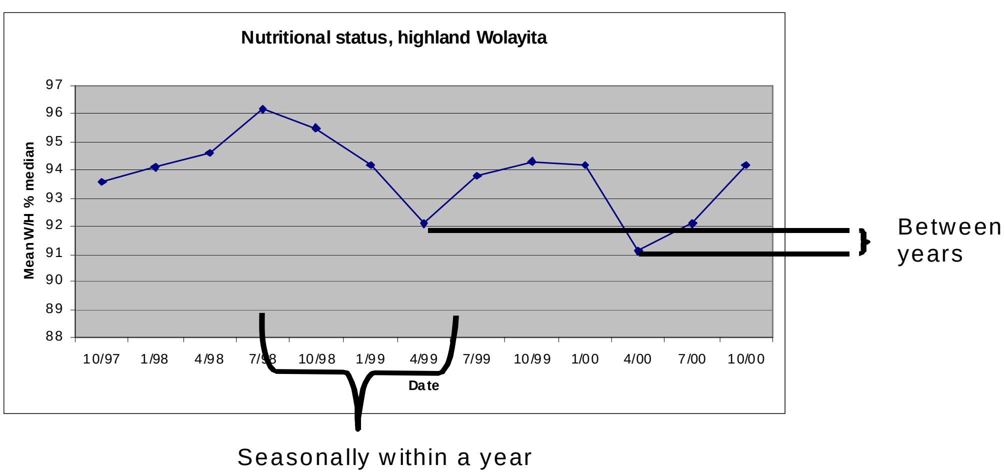


Figure 14. Seasonal variation in nutritional status, Wolaiyita, Ethiopia

This variation leads to a difficulty in interpreting nutritional status data. Taken in isolation, nutrition survey information can be clearly interpreted only

- By comparing current survey results with equivalent results from the same season of an earlier non-crisis year. In practice, comparable seasonal nutritional status information is only rarely available.

- If the nutrition findings are at an extreme, and are clearly normal or abnormal, e.g., a WFH prevalence of 3% or 50%.

The only practical way to overcome this difficulty is to set the nutrition findings in a food security context. The aim is to find out what has happened to people's access to food, and to use this to

- explain the observed nutrition findings, i.e., say if they are likely normal or abnormal
- predict how nutritional status is likely to evolve

Figure 15 shows a hypothetical situation in which the malnutrition rate varies over time. The rate falls after a harvest, increases as food becomes short, and increases markedly after a reduced harvest. A nutrition survey is done at a point where rates of malnutrition are high, but falling. The survey results would be a poor guide for forward planning (e.g., for large amounts of food aid) as the situation would be expected to improve.

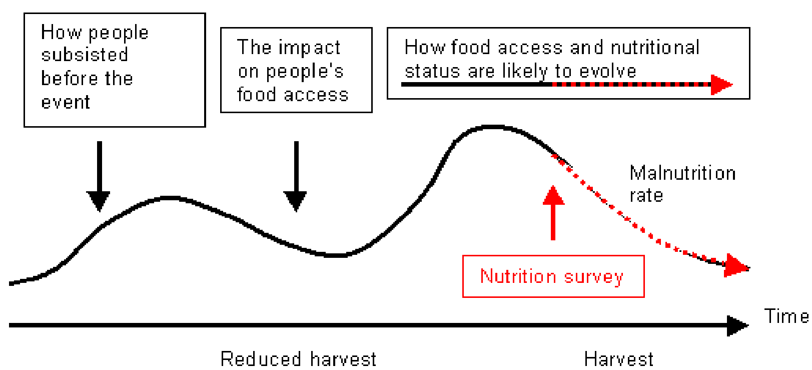


Figure 15. Food security information and the trend in nutritional status

6.1.3 The context in which an assessment is done

Rapid food security assessments may be conducted in a variety of contexts, at different geographic scales, and at different times in the evolution of a crisis. Most assessments are conducted in rural areas either 1) to predict the impact of an adverse event (e.g., crop failure from drought) on food security, or when a food crisis is already evident.

The following guidelines could be used in both situations but apply chiefly to the second case, which operationally is most commonly encountered. Assessment in camps and urban areas requires some modification of technique and is not discussed in this manual.

Box 8. Salima District, Malawi: Telling the story and making a prediction

The Facts/Current Situation

In much of southern Malawi, the March/April 2001 maize harvest was reduced by 20%–30%, chiefly due to waterlogging. From July 2001, the maize price steadily increased (largely due to other factors), and by February 2002 reached 4–5 times the usual seasonal price. In December 2001, a nutrition survey showed a global malnutrition rate of 9.3%. From historical data, this rate was known to be fairly typical for that time of year.

The Operational Questions

1. Is the observed rate of malnutrition seasonally "normal"?
2. How is the rate of malnutrition likely to evolve? If it was expected that nutritional status would deteriorate, this would have major operational significance. Malawi is landlocked, the only available food stocks were in South Africa, and the regional price of food and transport was high.

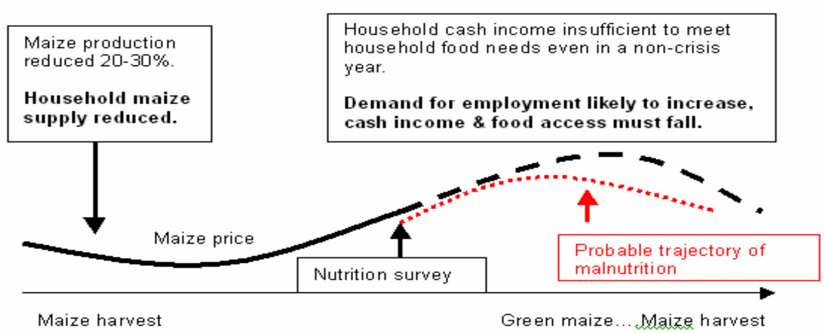
The Food Security Assessment

A food security assessment revealed that

- The main maize harvest is in March/April, although some green maize is consumed from February.
- The poor make up approximately 40% of the population and produce only a small part of their own consumption needs. From October until the harvest in March/April they depend heavily on income from day labor to get cash to purchase food. Work (mostly day paid agricultural labor) can be difficult to find, even under non-crisis conditions.
- This poorer category have only small reserves. At most, household assets include 1–2 goats and some household property, i.e., in terms of purchasing power for food at the increased maize price, there is virtually no value.

What is the probable significance of nutrition findings?

The best estimate was that the poorest people would be unable to secure enough income from additional work, or by selling household assets, to meet even their minimum food needs. Nutritional status was likely to continue to deteriorate until the first green maize was available when it would start to improve. It was also estimated that the maize harvest in the following year would be reduced because of the increased consumption of green maize, and that a problem with food access would therefore continue into the following year.



6.2 Doing a food security assessment

It is useful to think about a food security assessment as a narrative that sets out to answer four questions (box 8):

1. How did people make their living before the event/shock?
2. What has affected or disrupted this, and what impact has it had?
3. How well are people coping with this?
4. How will people's access to food be expected to change in the near future?

Repeated nutrition surveys can be used to monitor the way in which nutritional status actually changes over time. The time and skill and cost required to conduct a rapid food security assessment depends on the purpose of the assessment and the size and complexity of the area to be assessed. Large-scale, fully quantified assessments are demanding: smaller local assessments, sufficient to build up a reliable picture of an economy and what has happened to it can be done with much less time and effort. With practice, such assessments can be done very rapidly and accurately.

6.2.1 Overview

The aim is to systematically build up a picture of the area, its people and economy, and the shock that has occurred. From this, we work out the impact the shock has had on people's ability to acquire food (figure 16).

The steps are as follows:

1. *Define the population or populations to be assessed.* Populations are defined as livelihood groups, i.e., in terms of the way in which people usually get their food and cash income. For instance, a settled population whose income is from agriculture and paid work (as in the Malawi example above) and a pastoral population who live chiefly from livestock products and sale of livestock to purchase cereals, would be different livelihood groups.
2. *Describe the wealth structure of the population,* i.e., the differences in livestock, land, and other asset holdings between poorer and better off people and the proportion of people falling into each wealth group. The definition of wealth is that used by the people themselves.
3. Describe, for each wealth group in each livelihood zone:

   a. How people in different wealth groups obtain their income in a defined reference year and how this varies between different wealth groups. The reference year may be a recent non-crisis year. Where an analysis is being done after a crisis has begun, this is usually the preceding year.

   b. *How much it is possible for people to expand their income* to compensate for any failure of their usual sources of income, e.g., in some places people may have food stocks, or be able to obtain wild foods.
4. *Describe the shock or changes to the economy,* e.g., crop failure from drought or flood, a change in food or other prices, and its impact on the economy.
5. Combine the economic description, the information on the shock, and the nutritional status information.

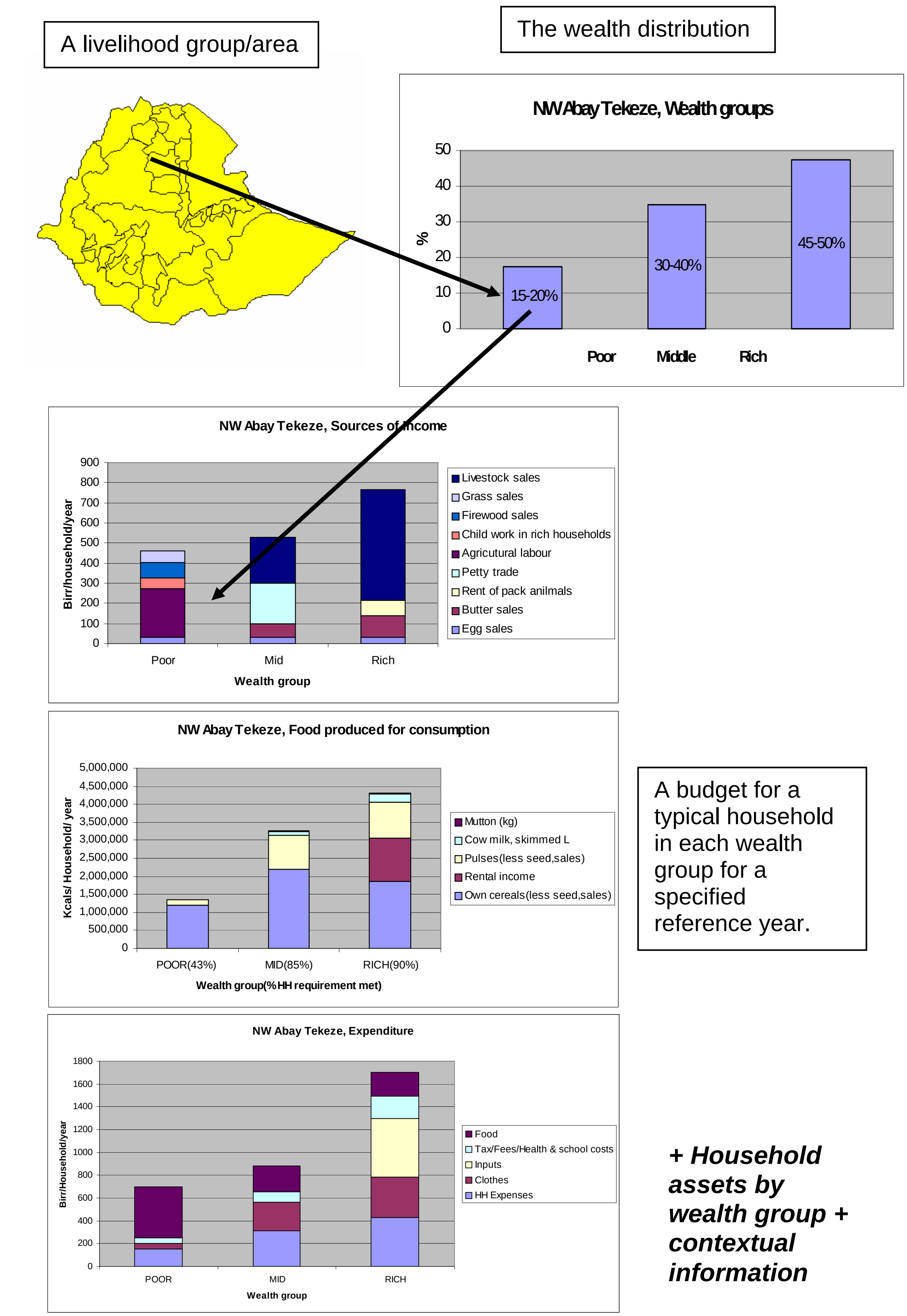


Figure 16. Information needs

6.2.2 Getting the information

On a rapid assessment, there is usually little time for background research or detailed quantitative surveys and most information will be obtained from *key informants* (box 9), as opposed to village/household-level interviews. Key informants are usually long-term residents of the area who have a specialized knowledge of the area or some relevant topic. By speaking to several informants, a complete picture of the economy can be built up. Confidence in the quality of the information can be obtained by triangulation, i.e., obtaining the same information from several sources as a check on the consistency of the information obtained. It can also be obtained from the internal consistency of the information, i.e., the information on household economy should be consistent with the food and other needs of the household. The keys to an assessment are to:

> **Box 9. Key Informants**
>
> Key informants are people who, by virtue of their position or experience, are capable of answering critical questions about the area, village, or wealth group. These may be the staff of the NGOs/PVOs on the ground, local government staff, local leaders, farmers, and traders. Ultimately, a good key informant could be almost anyone from the area with the interest and experience to build up a picture of some aspect of how people live.

- Take a structured, systematic approach. This ensures that all critical information is collected.
- Obtain information from several sources to triangulate the findings and ensure that the information obtained is consistent.
- Use open, semistructured interview techniques.

How this is done will depend on the circumstances. It may be possible to assemble a group of people (e.g., local NGO employees) and develop an overview in one session, following this with individual interviews. Occasionally one good key informant may be able to supply much of the information, or it may be necessary to seek out individuals (administration, NGO employees, farmers) to build up the data required. The following section describes the approach to assessment in a typical rural situation.

6.2.3 Getting started

An assessment often begins with little or no information about the area. The approach is therefore to develop understanding in broadly two stages: get a broad overview of the area, its people and economy (box 10); and refine this and build up a more detailed and confident picture by concentrating on each aspect of the economy in turn.

6.2.3.1 Getting a quick overview of the economy

Before starting any discussion become as familiar as possible with the area. It is much more difficult to inquire about a place you have not seen. At the very least, before embarking on any systematic discussions, walk or drive around the area. If possible obtain a reasonably large-scale map of the area. Printed maps are often locally unavailable, out of date, or very large scale. Recent maps accurately showing human settlement are usually unobtainable.

Always base the discussion on a map. If a suitable printed map is not available, hand-draw an outline map and draw in the roads, rivers, towns, and major topographical features with people who know the area well.

An accurate population census is not required, although it is useful to have an approximate idea of the population and the relative population of different livelihood groups.

A rapid overview should give a good preliminary idea of the major geographical features of the area, patterns of settlement, ethnicity, communications, other main differences between groups, and the main features of the economy of each group, including their dependence on trade.

On common difficulty is insecurity, which may make it difficult to travel within the area. Although it is more difficult to do, an assessment can be done without visiting an area at all, if informants can be found who have recently left the area.

Box 10. Getting started

Establish the following:

- The chief areas where people are settled and any ethnic and language differences between groups.
- The economic activities people engage in and any variation in these within the area and between different groups.
- The main crops cultivated and livestock types, and the use of these (i.e., consumption or sale) and the relative importance of each.
- Types of paid and self-employment.
- The markets used for different goods and their location.
- Population movements.
- Seasonality: rainfall, timing of the main agricultural activities (planting, weeding, harvesting) for the principle crops.
- Asset holding.

6.2.4 Building up a more detailed picture of the economy

6.2.4.1 Define the population or populations to be assessed

6.2.4.1.1 Defining Livelihood Groups

The aim of livelihood grouping is to separate populations into more manageable and understandable groups, each of which can be analyzed separately. A livelihood group is defined in economic terms as a group of people who make their living in broadly the same way (box 11). In most rural areas people's economy is still often largely determined by land use, and livelihood groups can usually be defined from the pattern of climate and agriculture. Most livelihood groups live permanently in one geographic area (a livelihood zone), although pastoral groups may be seasonally mobile. More than one livelihood group may be found in the same geographical area.

On a small-scale assessment, there may be only one livelihood group, such as a settled population of the same ethnic group with, broadly speaking, the same pattern of crops, livestock, and work opportunities. In some cases, there may be features of the area or other information that suggest the economy of a significant part of the population is sufficiently different to make it useful to subdivide the population. For example, people close to rivers may be able to get a second crop or obtain income from fishing. People living by roads may make their living from trade rather than agriculture.

Box 11. Defining Livelihood Groups

See if it is possible to get an agro-ecological or agro-economic map (showing resource use, market access). Base discussion around a map. Use a sketch map if necessary. Draw in settlements, roads, rivers and other major features.

Identify major differences in how people live, including ethnic groups, land types, altitude, rainfall, access to rivers and other productive water sources, crops grown and livestock owned, and access to employment and other economic opportunities.

Mark the livelihood groups that emerge on a map, name the different groups, and note the geographic area they occupy.

Establishing livelihood groups and deciding the extent to which to subdivide them require some judgment. The important points are

- not to mix up very different economic groups, e.g., a livelihood group that includes both pastoral and cultivating groups
- not to subdivide a livelihood group unless there is a very good reason for doing so (as this adds considerably to the amount of work required)

Common difficulties include small population groups within a larger livelihood group, e.g., small urban areas and roadside settlements that have a fundamentally different economy. If, as is often the case, it is clear these groups do not face a serious problem, they should be omitted from the assessment. Another difficulty is pressure to use administrative boundaries to define livelihood zones, because relief is often managed on administrative lines. In practice it is usually straightforward to apply an analysis based on livelihood groups to administrative zones after the analysis has been done.

6.2.4.1.2 Timeline and the Reference Year

In most assessments, the aim is to get a clear idea of the economy in the period prior to a shock or other event. To do this it is necessary to establish a reference year, usually the most complete year preceding the shock. The analysis is conducted with reference to this year. In rural agricultural economies it is usually easiest to discuss agricultural years, i.e. , main harvest to harvest. Results can be converted to the January–December calendar later.

It is also helpful to get a clear idea of how the economy in a livelihood zone has varied over a number of previous years. All economies have good and bad years. Crop and livestock production vary with rainfall and crop and livestock disease, employment opportunities fluctuate, and prices of goods and services may change.

Understanding the ups and downs of an area’s recent history gives insight into how people manage in bad years and is likely to be relevant to understanding the current situation. For example, knowing that a population has faced several consecutive difficult years will have very different implications than if the current year is the first difficult year following many average or good years. In some, particularly semi-arid areas, large swings in production between years may be the normal pattern, e.g., in a 10-year period there may be 1–2 good years, 3–4 fair years, and 2–3 years of crop failure. In such situations, people often store surpluses in good years to meet deficits in bad ones. The analysis must take this into account.

Box 12. Timeline and Reference Year

Government (e.g., ministry of agriculture) and NGO/PVO reports may give a recent history of the area.

Key informants.
Establish:

- the beginning and end of the local annual calendar (often be the agricultural year, e.g., planting-to-planting of the main crop)
- if there are local names for each year or for memorable years
- the characteristics of a good year, a bad year, and a year that is neither good nor bad asking why, using actual years as examples:
  1. Work backwards from the current year getting a description of the main events in each, and how this affected peoples' livelihoods.
  2. For bad years, find out how people responded.
  3. Rank the years on a 1–5 scale, taking 5 as the best year and 1 as the worst. Cross-check that it is consistent with the earlier discussions. Proportional piling may be useful.
  4. Decide on a reference year to use for more detailed discussions.

Do not go back more than 10 years. In most cases five years will be enough.

Years should be ranked to compare year types for their overall quality, which is then useful to identify a reference year (table 8).

Table 8: Year rankings for North Wollo Highland Belg Zone, Amhara Region, Ethiopia

Year	Rank	Description
2004–05	**1**	Very poor rains. No crop development. Deteriorating livestock conditions. Return of borrowed sheep from poor to rich. Similar to 1999–00.
2003–04	**5**	Good rains. Best harvest in past 10 years. Excellent livestock conditions and production.
2002–03	**3**	Average rains and harvest. Fairly typical year.
2001–02	**2**	Poor rains and year. Food aid distributions.
2000–01	**1**	Severe drought. Large food aid distributions. Excess livestock sales.

6.2.4.1.3 Coping

Information on coping strategies is often most easily gathered when collecting the timeline information, although more can be gathered during the household interviews. In many situations where an assessment is being conducted following a shock, people may resort to using such methods to survive.

Sorting out activities that are normal and abnormal can be difficult, e.g., people may sell livestock as a regular source of income or as an act of desperation (box 13).

Box 13. Coping' strategies

Households usually have a variety of ways, sometimes known as "coping' strategies" they can use to sustain their food supply in bad years. These include

- reducing consumption of food and nonfood expenditure, e.g., on education, clothing and soap
- consuming savings and assets, e.g., food stocks, using cash savings to purchase food, selling livestock and other assets to purchase food
- intensifying existing sources of income, e.g., falling back on wild foods, hunting etc., or attempting to find paid work elsewhere

In practice the options available, particularly to poorer people, may be very restricted, e.g., wild foods are scarcely available in many places, the poor lack livestock, food stocks, and other reserves.

Coping may also involve high costs to the household. For example a household may be able to survive a shock but only by selling livestock and other assets, eating unsuitable foods, or engaging in prostitution or other dangerous occupations. In extreme cases, a household may survive in the short term, but only at the cost of long-term destitution. Long distance migration may involve personal risks and social costs and the reduction in nonessential expenditure may lead to children being withdrawn form school or not receiving healthcare.

Care should be taken to differentiate between

- normal seasonal patterns of income and coping that some poor households may have to use in any year, e.g., in many locations the poorest groups endure a period of semistarvation and forgo most nonfood expenditures for a period of every year
- a more general change or intensification of coping activities in more difficult times, e.g., a year of crop failure
- unsustainable activities sometimes known as "distress strategies," which might include the movement of whole families to towns, and desperate acts such as eating maize bran or grass.

During the development of the timeline, you may have identified a previous year similar to the current one. If so, ask what strategies people used in that year. If not, questions are usually best put in hypothetical terms, e.g., "What would people do if…?" If the current year is a crisis year ask what people are currently doing to maintain their income.

Once the types of strategy used have been identified, find out how people in different wealth groups, particularly the poor, used these in the identified year to maintain their income, and how successful this was.

Rank the strategies, in order of which are early/late and most important/less important. Where people have a choice, the tendency is to take steps that allow survival, such as reducing food intake, before selling livestock and other productive assets that will jeopardize long-term survival.

6.2.4.1.4 The wealth distribution

The aim of defining wealth groups is to understand the distribution of wealth in each livelihood zone, i.e., the proportion of people falling into each wealth group, and the difference in their livelihoods (box 14).

Just as the same external shock will have a different effect on two separate livelihood groups, it will also have a different impact on families with different patterns of income and with different levels of assets and other reserves.

Within one livelihood group a distinction must be made about the ways in which different families live. This is done by establishing a *wealth distribution* for the population—the proportion of households that fall into defined wealth groups (figure 17).

The definition of wealth used is that used locally (box 15). In many areas there are local, vernacular terms for each wealth group. It is common to find three or four wealth groups, although in rare cases there may be as many as seven (figure 17).

"Richness" is almost always defined by the productive assets held by a household, rather than the level of consumption. Better-off people will obviously tend to have greater consumption levels, although in some settings the difference may be small. For instance in pastoral areas, wealth may be defined by the number of livestock held; in agricultural areas, the amount or quality of land, or in places where income depends on employment the amount and quality of labor available to a household, although combinations of these are common.

Box 14. Wealth groups are not necessarily the same as vulnerability groups

Defining wealth is not automatically defining vulnerability. It is not possible to talk about vulnerable groups without defining what people are vulnerable to (cattle disease, drought, market closure), as different livelihood groups, wealth groups, and households are vulnerable to different things. A poor household, with goats but no cattle, is not very vulnerable to a cattle disease epidemic, but may be very vulnerable to a food price rise, as a large proportion of food is purchased from the market.

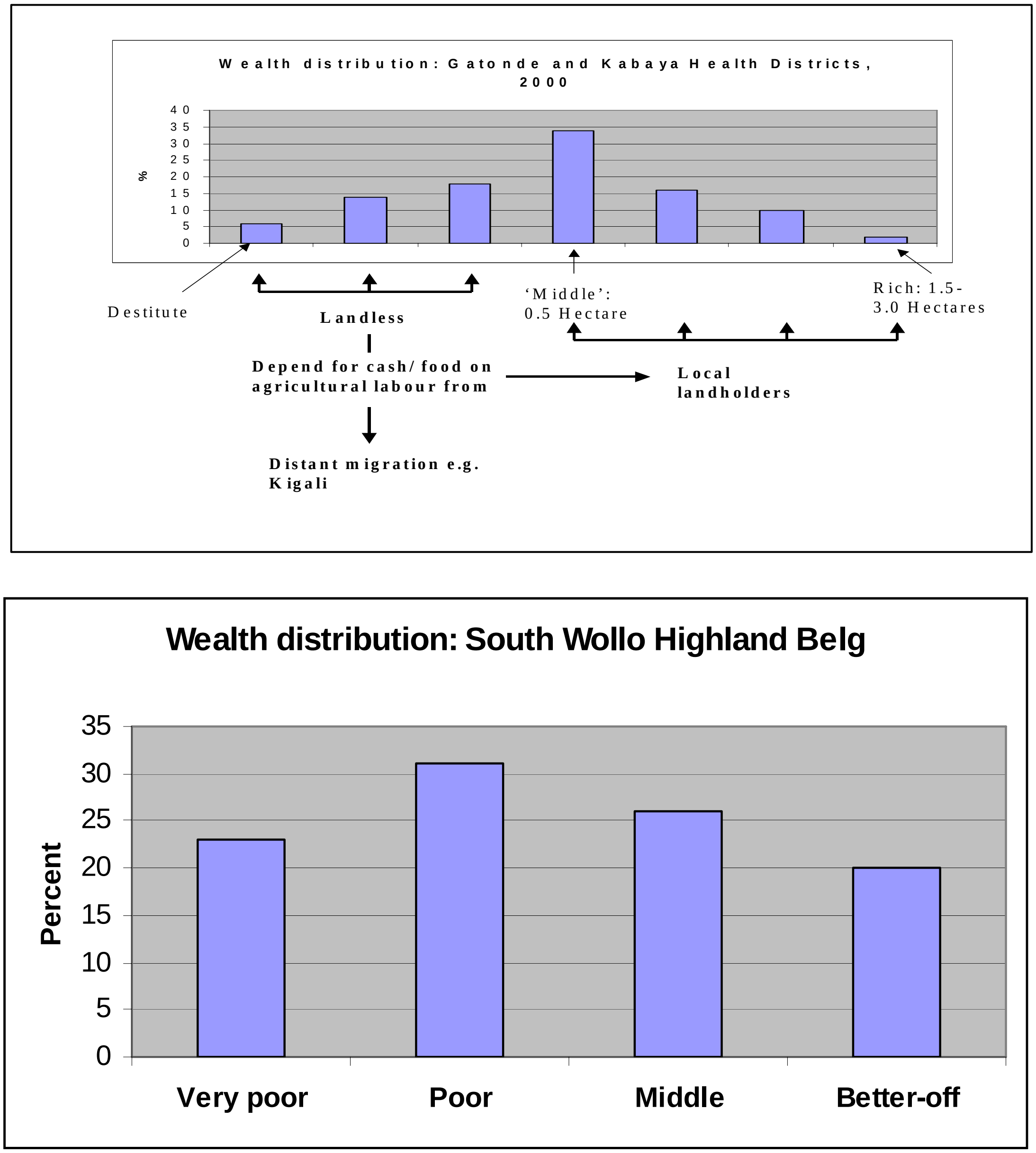


Figure 17. Top: Wealth groups in Gatonde and Kabaya Health Districts, Rwanda, 2000. The population was displaced by fighting in 1997/1998 and had recently returned to the area. There were virtually no livestock. **Bottom: Wealth distribution in highland Ethiopia.**

At this stage it is also useful to obtain an estimate of the assets available to each wealth group, as these often represent a large part of the household's ability to withstand shocks (table 9). Tradable assets include livestock holdings (which are the major investment and reserve in most agricultural and pastoral economies), food stocks, and cash savings.

Table 9: Wealth group characteristics

Characteristics	Poor	Middle	Better off
% of Total Population	50%–60%	25%–35%	10%–15%
Land cultivated	1–3 acres	5–7 acres	8–10 acres
Livestock	0–2 cattle < 5 goats 10–15 chickens	5–10 cattle (1–2 milking) 10–15 goats <5 sheep 15–20 chickens	15–25 cattle (2–3 milking) 20–30 goats 10–15 sheep 15–25 chickens
Household size	6 (1 wife)	6 (1 wife)	11 (2 wives)
Main activities	Agricultural labor, brewing, selling thatch, construction, selling vegetables and wild fruits, crafts	Selling livestock, brewing, selling thatch, selling vegetables, wage employment outside district, fishing	Selling livestock, selling cotton, brewing, selling vegetables, wage employment outside district

Box 15: Identifying wealth groups

This can be a sensitive subject as it concerns wealth (and power). In group discussions avoid terms such as "the poor" and "the rich." Find out if there are local terms for wealth groups. If so, use those. If not, use "better-off" or "worse-off."

- Find out what makes people better- or worse-off? Land? Cattle? Are some people more affected by particular shocks, e.g., drought or conflict?
- Exclude wealth extremes from the discussion (the destitute, disabled, etc.) and very rich (e.g., a single landlord, shopkeeper, or other very rich household). You are interested in the more common and general categories of wealth)

Go through each group identified and establish

- the approximate household size and composition of each group
- their assets (land, livestock, food stocks, and cash)
- ranges to estimate numbers (e.g., 3–4 cattle owned for most typical households; 1–2 acres planted by most poorer people)

Ask about the relationships between the different groups. Do the poor work for wealthier households?

Estimate the proportion of the (livelihood group) population in each category. Proportional piling exercises may be useful if people are unfamiliar with percentages.

6.2.4.2 Seasonal Calendar

Rural livelihood patterns usually change significantly from season to season. The availability of many food and income strategies and options is seasonal, as are some expenditure patterns. Understanding when different sources of income are obtained is necessary to estimate how needs will vary with the timing of a shock (box 16, figure 18).

Box 16. Seasonal calendar

Use flip chart paper or one sheet of paper for each source of food and cash income. Mark the months down the side. Use local months and the agricultural calendar if this is easier for the respondents. Establish the main seasons and their characteristics, identifying local names, and major characteristics (rains, dry, hot, etc.)

Income

For each main crop and other economic activity in turn, work through month by month and establish:

- crops—the timing of harvests
- periods when wild foods (including fishing and hunting) are available
- livestock—times when milk is more plentiful, livestock migration, and peak- and low-sale levels
- periods at which the main sources of employment are available, e.g., petty trade, gathering firewood, construction materials, etc.

Ask whether there are particular names or characteristics that are useful and descriptive, such as "the hunger season" or "the time of plenty."

Expenditure

- seasonal pattern of food purchase and other major expenditures—water, agricultural inputs, schooling:
- 0rices of main commodities purchased and sold

Draw these patterns on a simple annual calendar

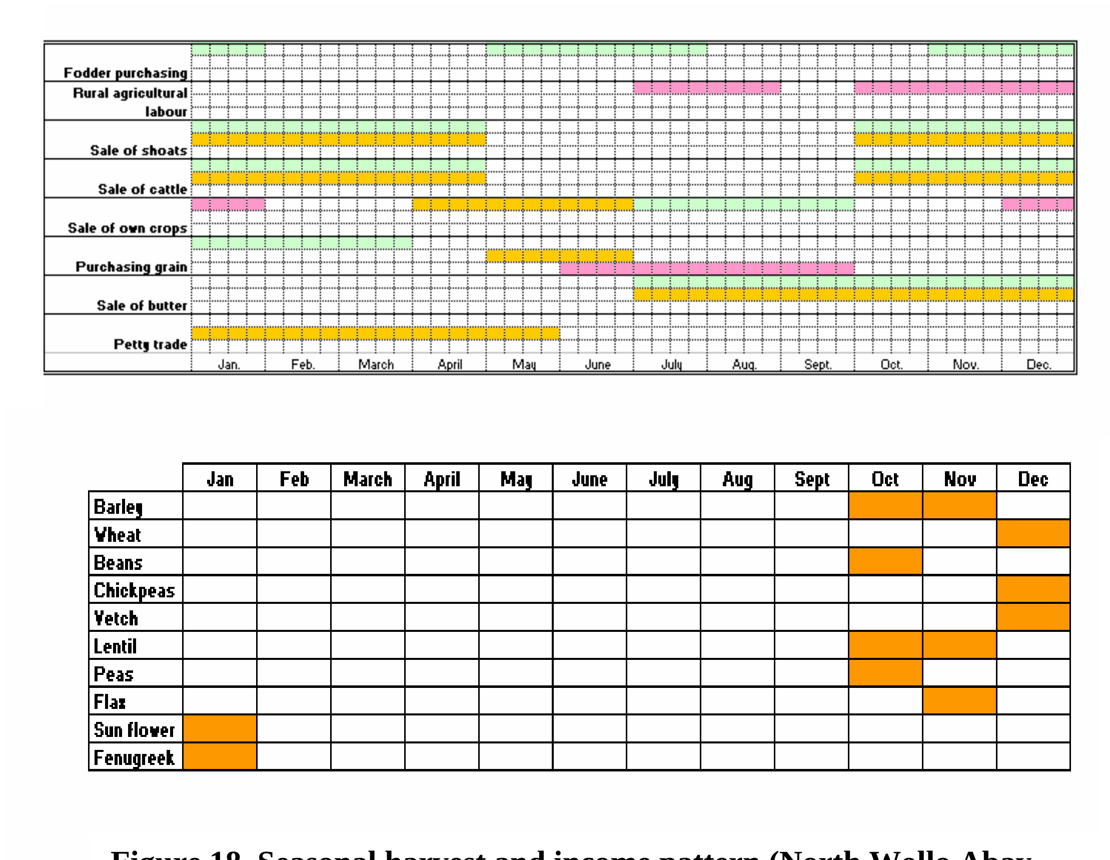


Figure 18. Seasonal harvest and income pattern (North Wollo Abay-Tekeze watershed food economy zone, Ethiopia)

6.2.4.3 Describing the economy of each wealth group

The aim is to find out how people in each wealth group obtain their food and cash income in the reference year. On a rapid assessment it may be sufficient to obtain income information only for the poorer part of the wealth distribution (boxes 17 and 18). This type of information is rarely available from secondary sources. Keep in mind that the aim is to find out how households get food and money in the reference year, not to document exactly what they eat. Knowing how households obtain food allows an estimate to be made of how a shock will affect access to food.

There are only so many potential ways in which people can get their food and cash income. By systematically working through these it is possible to build up a picture of a household budget for the reference year.

People obtain their income in three main ways:

1. by producing food for consumption (i.e., crops and wild foods)
2. by exchanging something the household has (e.g., crops, livestock) or does (e.g., labor) for food, on commercial terms; exchange is usually through a market and is a cash transaction, but will occasionally be done through barter

3. as gifts, i.e., flows of food, money (and occasionally livestock and other goods) on broadly nonmarket terms; gifts may be just that (e.g., free relief food) or involve some return from the recipient (e.g., some token work or the expectation that the gift will be returned at some future time when the giver is in need)

Box 17. Describing the economy I

Before starting discussion be sure that you know the types of income obtained in the livelihood group, the seasonality of crop, employment, and wild food income. The informant should be someone who has a close knowledge of village economy, i.e., someone from a village.

Work systematically through the three production categories

- crops produced by the household
- livestock and livestock products (milk, meat, eggs, blood) produced by the household
- wild foods/hunting.

Then work through the five exchange categories:

- crop sales (including cash crops such as cotton or tobacco or the sale of food crops
- sale of livestock and livestock products
- wild food sales
- labor sales, subdivided into paid employment (e.g., agricultural labour, government service), self-employment (e.g., firewood, charcoal, handicrafts, transport, and resale of goods/petty trade, remittance, etc.), and gifts (of food or cash) and gift sales (e.g., of relief food)

How people—particularly very poor people—use these options is not always straightforward. For example, people may sell food crops after the harvest to get cash to pay school fees, then have to buy food from the market later in the year, often at a higher price. However, for a rapid assessment, all you need to know is how much income the household obtained from different sources in the reference year.

This information is obtained by systematically working through the production and exchange headings (see boxes 17 and 18) with an informant to get an estimate of the income from each source. From the previous steps and before the start of this discussion you should already have identified the wealth groups and their assets; and know the potential sources of income for the livelihood group, the seasonality of each, and about coping strategies in bad years.

6.2.4.4 Note for describing economies

6.2.4.4.1 Units

People do not always work in metric or other conventional units. Imperial units (e.g., acres, pounds) may be used, traditional units (e.g., maunds), or bags, cups, tins, pails, and other local units. Local units should be used in recording the quantity of income obtained. As units will have to be converted to metric units for the analysis, it is important to ensure that their metric equivalents are known. It is often the case that key informants know the metric equivalents, at least of the main marketed crops. Bags are typically 50kg. It may be possible to calculate other volumetric units from this (e.g., if it is known that, for a particular crop 5 pails = 1 bag, 8 bags = 1 oxcart). Otherwise the quantity concerned must be weighed. Bundles, bales, etc., may have a metric weight equivalent (as for cotton). Otherwise, ensure that the price of one bundle (or bale) is known.

For items that involve a large amount of processing waste, take care to specify whether the item is processed or unprocessed, e.g., groundouts may be reported as shelled or unshelled.

Box 18. Describing the economy II

Secondary sources are not always available or reliable and do not often have information in the format required here. From the previous discussions a *qualitative* description of the main features of the economy is available, i.e., the main crops produced, harvest times, types of paid employment and self-employment, wild foods etc.

All that is required is to work systematically, wealth group by wealth group, through the main income headings, to build up a picture of the pattern of income of each group.

Ensure that the informant is clear about

- which wealth group (“poor,” “middle”) is under discussion
- the discussion referring to the reference year
- the size of the household under discussion
- using local units, e.g., bags, tins

Work though each source of food and cash income in turn to quantify it and establish its relative importance to that wealth group.

If time allows, repeat the discussion at other representative sites.

6.2.4.4.2 Minor income sources

On a rapid assessment do not dwell on very small sources of income. For instance, a variety of types of wild fruits are eaten in many places. These are often of very low energy value, and highly seasonal. If it is clear these cannot be more than a very small proportion of income, they can be ignored (box 19). Children, particularly boys, are often partly “self–provisioning” (they may obtain small jobs for food, hunt, and consume small birds and other animals), but in the context of a rapid assessment, the contribution to household income is often very small.

6.2.4.4.2.1 Paid and self-employment

Employment is often highly seasonal, following the pattern of agriculture, or—particularly off-season—taken piecemeal as the opportunity arises. Wage rates may vary seasonally and be different for men and women. Work through each employment type month by month, for men and women separately if necessary, and find out approximately how many days employment is obtained in each month.

> **Box 19. "Appropriate imprecision"**
> The precision of the estimates depends on the intended use of the data. In a rapid food security assessment the usual aim is to understand the impact of a gross change, e.g., major drought or crop loss, collapse of employment on economy, usually on people who already live on an economic edge. Under these conditions the omission of small items of income and the use of approximations is unlikely to make much difference to the analysis.

6.2.4.4.2.2 Remittances

Ask if there are people working outside the village, and if so, where they are working, how much time they are away, and the contribution that they make to household income. In some cases it will be found that remittances from workers overseas will be among the largest income sources.

6.2.4.5 For how many wealth groups should information be obtained?

The aim of a rapid assessment is usually to determine the ability of the poorest groups to acquire sufficient food. If time allows, try to get information for at least three groups. Of course, where there are a large number of wealth groups, it would be impractical to obtain information on all. However, sufficient groups should be included to provide a representation of the whole population, i.e., a poor, middle, and better-off group. Or, if time is limited, ensure that information is obtained at least for the poorest and middle groups—those most likely to be in difficulty.

6.2.4.6 Standard of living

Lastly some information will be required on the nonfood costs of maintaining a basic standard of living. Typically this would include

- personal costs, i.e., clothing, soap (personal and clothes washing)
- household items, i.e., fuel (often a small amount of kerosene or diesel used for lighting), cooking utensils
- education costs (even if no direct charge is made for school there are costs for books, examination fees, etc.
- health costs[53]

[53] as health costs vary a great deal from household to household, a reasonable compromise is to add an amount sufficient to meet the costs of basic routine care, e.g., transport costs for immunization, 1–2 clinic visits by each child per year, including transport costs and, where relevant, user fees, and drug costs.

It will often be found that the actual nonfood expenditure of the poorest groups will fall below even the most basic standard of living, at least seasonally.

6.2.4.6.1 Common difficulties

Knowing if the information obtained is reliable. This can be checked in two main ways:

1. Household income should be at a level consistent with household food needs. During an interview, keep a running account of income sources as you go along to ensure that the food income (including food purchase) adds up to a quantity consistent with household needs, and that the cash left over is consistent with the observed standard of living. It is helpful to memorize the approximate quantities of staple foods that are required by a defined household, e.g., a household of five will use approximately a ton of cereals (20 bags of 50kg) a year (box 20) and the approximate nonfood costs of a household in that wealth group.
2. More than one key informant discussion should be held for each wealth group to triangulate the findings. The findings from different interviews should be reasonably consistent.

> **Box 20. Food energy needs**
>
> For relief calculations an average of 2,100kcal per person per day is often used. A household of five would require 5 x 2,100 x 365kcal/year = 3,832,500kcal/year. In many areas the actual food intake of poorer household is often less than this. An average of 1,800kcal/person/day is not an unusual finding.

Occasional income sources, e.g., fishing, might be classified under different headings. For example, sea or river fish might fall under hunting; fish farming under livestock; and mango trees may be semi-wild or private property. For a rapid assessment either classification will do, as it makes no difference to the analysis. The important thing is to ensure that all major sources of income are included.

6.2.5 Defining the shock

In understanding people's food security, it is necessary to define the shock that has occurred, in terms of its relationship to people's sources of food and income. For instance, cereal production may be reduced for a variety of reasons, e.g., drought, flood, or transport failure. Whatever the immediate cause, the shock is defined as *the actual impact this has had on production and/or prices*, as it is this that affects the food security of people in the defined livelihood groups (box 21).

The way in which a shock has affected the economy can be estimated in two ways:

- *Official sources* may sometimes be helpful for estimating crop production, although official crop statistics are often reported with respect to administrative rather than livelihood zones and are not always available until some time after the event. Local agricultural extension officers are often good key informants and may have a good overview of an area. It is rare for official statistics for current livestock production, employment or other sources of income to be available at all.

- In most cases the information will have to be obtained locally. During the timeline discussion, information will have been obtained on variation in production between different past years. By comparing the current shock with historical trends, it is usually straightforward to develop an estimate or estimates of the severity of the shock that has occurred.

Box 21. Hazard economic effects

Hazard	*Economic effects*
Drought	–reduced crop production (e.g., crop production 30%–40% of normal) –reduced livestock production (e.g., milk yields half of normal) –loss of income from cash crop sales, livestock sales, or loss of employment on local farms (e.g., daily wages 50%–70% of normal) –change in availability of wild foods (25% of normal) –change in availability of fish (30%–50% of normal)
War	–market closure (e.g., staple food prices doubled) –loss in crops/livestock/inputs from looting (e.g., crop production 30% of normal) –reduced access to critical land for planting or grazing (e.g., milk yields 20%–30% of normal) –disruption of trade and transport (e.g., effective 75% reduction in livestock prices) –reduced access to outside assistance (e.g., food aid) –displacement (total loss of food and cash income for displaced and increased demands on host population)

Production shocks are usually expressed as a percentage, relative to production in the reference year, e.g., that maize production is 80% of reference production, rather than absolute quantities (box 22).

Box 22. Describing the shock

Go systematically through the main categories and sources of income and find out *relative to the reference year*

- the estimated percentage change in each main source of income from production
- any change in the price of the main traded items (livestock, labor rates, food)

Where there is uncertainty use a range, e.g., "sorghum production is 50%–60% of the reference value."

6.2.5.1 Common difficulties

1. If the rate of price inflation is very high (e.g., as sometimes happens in war zones), the cost of food or other items may appear to have risen, even over 1–2 years, when in fact it has not. The true change in value of a commodity can be established by looking at the relative value of different items.
2. A range of estimates may be obtained from different sources. Record any variation in the form of ranges e.g., sorghum prices increased by 30%–40%, or production is only 70%–90% of (or 10%–30% below) that in the reference year.

6.3 *Estimating the impact of a shock on food access: Putting nutritional survey results in context*

Box 23 discusses analysis for predicting the impact of a shock.

Box 23. Prediction

Where an analysis has been made to predict the impact of a shock, e.g., an anticipated harvest failure, before people have had to compensate for reduced income, an analysis requires decisions on the following:

- The proportion of any assets that the population should be allowed to retain. For example, if a wealth-group household has 10 goats, how many should the household be "allowed" to sell? For the poorest groups, the decision is often made easy by the fact that the asset base is often so small that it can be ignored (table 5). Land, agricultural tools, household furniture, and the other basic requirements for long-term subsistence should not be included if the sale of these would be necessary to survival. Wild foods should be included only in the (now rare) case that these are readily available, nutritionally useful, and do not require extraordinary processing to make edible; and long-distance migration takes place only if this is not unduly hazardous.
- What is an acceptable level of nonfood consumption, e.g., soap and clothing. If no allowance is made for this, food (e.g., food aid) will be sold to purchase essentials, and food intake will be reduced.

6.3.1 Steps in conducting an analysis

A worked example is given in the next section. The steps are **as follows**:

1. Calculate the amount and proportion of income that each household type/wealth group obtains from each food and cash income source.
2. Combine the income and the seasonality information to develop a timeline to "explain" how food access has changed in the period before the survey, and to project this into the future. This can then be compared with the nutrition findings.

The way in which this is done will depend on the time at which the food security assessment is being done relative to the shock. There are broadly two situations:

1. Where an assessment has been done after a food security problem has already arisen, people will have already adjusted to the crisis to the extent possible, e.g., sold assets and consumed other reserves. This is the most common situation where anthropometry is undertaken. This situation is used is used as the basis for discussion.
2. Where an assessment is being conducted with the aim of predicting the effect of a shock (e.g., a crop failure has occurred and the need is to know how food security is likely to evolve in future), there may be an opportunity to take action before food access and nutritional status fall. In this case, analysis requires some further judgments to be made (box 23).

The calculations required are simple but the numbers can become large, and it is easy to make errors. The calculations are most easily done using a spreadsheet. Where there is doubt about the value of some variables, a spreadsheet also allows several scenarios to be tested quickly. For instance, if the estimate of crop production in the current year is in the range of 60%–70% of reference year production, analyses can be done using the lower and higher estimate.

A spreadsheet (SMART_FOOD_SECURITY_CALCULATOR.xls) is provided with this manual. This has three worksheets:

1. A simple calculator that allows the household budget data to be entered reconciled and checked.
2. For the entry of seasonal information e.g., the percentage of a particular crop that is harvested in a particular month.
3. Calculates the expected food access of each wealth group, under conditions specified by the user.

The spreadsheet allows an analysis to be done for a livelihood zone with up to four wealth groups. The spreadsheet is supplied with data for a livelihood zone already entered. An additional copy of the spreadsheet should be made for each new livelihood zone to be entered.

6.3.2 Step 1: Worksheet 1. Calculating the amount of income obtained from each income source

Worksheet cells in which data is to be entered by the user is in blue (figure 19). Values in black are calculated automatically by the spreadsheet. For each wealth group enter the following:

1. Wealth group name, proportion of the population in each wealth group, number of people in the household, and food energy requirement/person/day.
2. Name of each income source, food energy values (see annex 2), and/or price of any traded item. Any units of income, e.g., bags, can be used as long as appropriate food energy and price values are used.
3. Reference values (quantity of income obtained from each source for each wealth group). The calculations will be done automatically.

4. Livestock and food stock holdings of each wealth group.

A summary of the total annual food energy and cash income is calculated and shown in the Summary box. To check the result to see if the summary results are consistent with the data and with the standard of living of each household, enter a food item or items to be purchased (in the “food to be purchased” box) and for each its price and energy value. Use the staple food(s) eaten in that area and the midyear price in the reference year. The percentage of household food energy requirement that the household can obtain (from production and purchase) and the remaining cash income (after food purchase) will appear at the bottom of the summary box. The result should broadly agree with the estimate obtained from key informants of the amount of food actually purchased and be in keeping with the amount of household cash income, the cost of food and the amount spent on nonfood essentials.

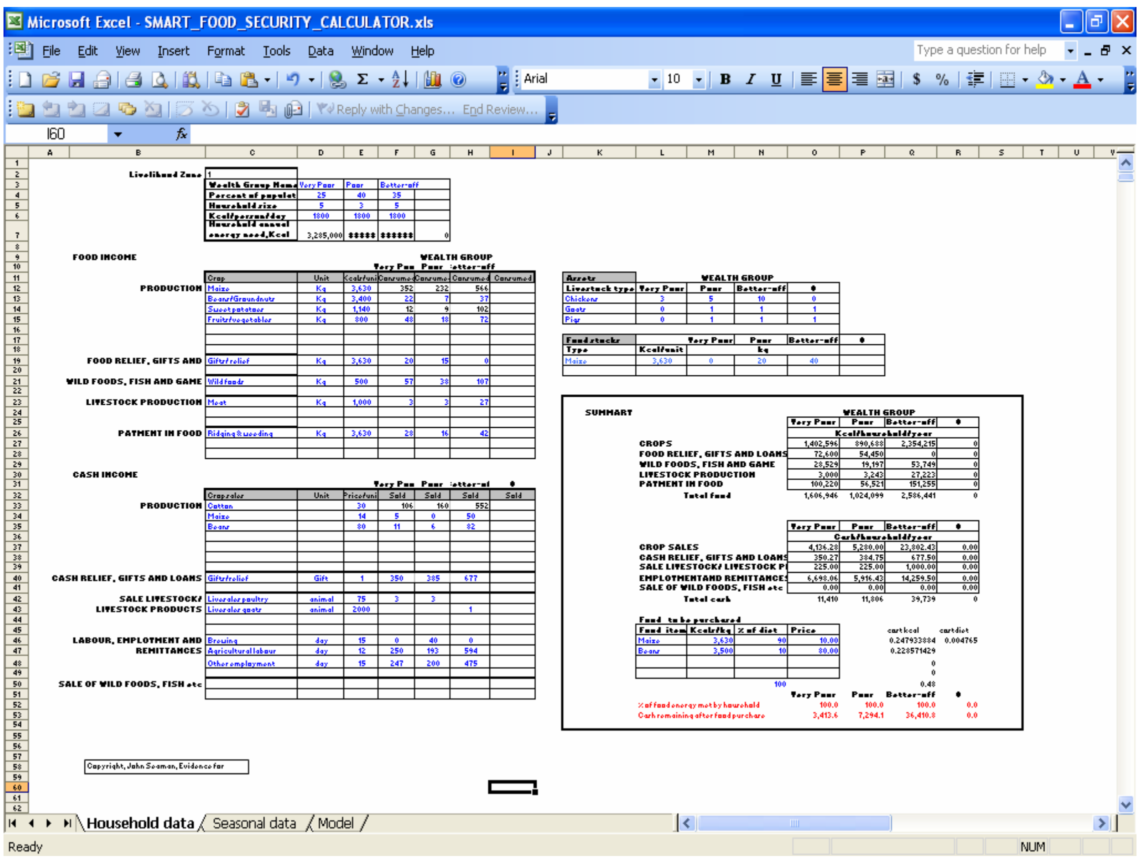


Figure 19. Worksheet 1: Calculator Spreadsheet

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6.3.3 Step 2: seasonal Worksheet 2

The sources of income, e.g., maize or agricultural labor, entered in worksheet 1 are automatically transferred to worksheet 2. For each income source do the following:

1. Enter the percentage of each income source obtained in the appropriate month column. For example, if the maize harvest is in March and April, with most of the crop obtained in April, the entries might be March 30%, April 70%. Note that the entries should add up to 100%. The total for each row is shown in the column on the right.
2. Enter a nonfood cost/household (at the bottom left of the seasonality section). The nonfood cost should represent the cost of a reasonable basic standard of living (section 1.2.4.6, the standard of living). The monthly nonfood cost will be calculated automatically

6.3.4 Putting the shock information and the economic description together to develop a food security narrative

Step 3: Worksheet 3, the model

Worksheet 3 calculates the percentage of household food requirement that each household can obtain, from its own production and food purchase month by month over a two-year period, given a set of conditions specified by the user.[54] The conditions that can be set include the level of production and income from different sources, food prices, the quantity of nonfood items that the household will purchase, and the extent to which a household can "cope" by selling livestock and other steps. Taken together these can be used to simulate the effect of a shock on household food access. The conditions are set in the top part of worksheet 3. Year 1 will usually include some or all of the most recent past year up to the point of the nutrition assessment. Part of year 1 and year 2 will be a forward projection from that point.

The changes that can be made are as follows:

1. The level of production or income set for each of the two years, expressed as a percentage of the reference income. For example, if drought caused a fall maize production to 50% of reference values, 50% would be entered in the relevant cell for year 1. The value for year 2 will be unknown. However it is possible to enter conjectural values for year 2 to allow the development of hypothetical scenarios. For instance, how would the situation be likely to develop if the harvest in year 2 were normal or only 80% of normal?
2. The price that people had to/ will have to pay to purchase food. The foods specified should be the cheapest available staple foods consistent with the reasonable survival of the people in the livelihood zone. A diet of up to four items can be entered, although in many situations one (a staple) or two items will suffice. In the spreadsheet example, the diet has been specified as 90% maize and 10% beans. The price of each item is entered for each month for each of the three

[54] This calculates 1) the amount of food available from production for each month in the reference year, year 1 and year 2, given the percentages of income set by the user; 2) the amount of food that a household would have to purchase each month to make up its requirement, allowing for carry-over between months e.g., production income tends to be concentrated in a few months; 3) nonfood and food expenditure is calculated, again allowing for carry-over of unspent cash between months. Year 1 begins with the starting values of the reference year i.e., it assumes a reference year preceding year 1. Year 2 begins with the output from year 1. "Coping" income, if set, is added in January of years 1 and 2.

years. This means that a judgment will have to be made about the likely evolution of price for any remaining part of year 1 and if the model is to be extended into year 2 for the whole of that year.

3. The "expandability" of the household economy, i.e., the degree to which people might obtain additional income in year 1 or year 2 by selling livestock, consuming food stocks, obtaining additional gifts (which can include planned relief), and by gathering/hunting wild foods. For livestock and other asset sales, the information required is the percentage of the asset that is to be sold in each year and the price (actual or anticipated midyear price) for each year. Food stocks are also set as percentages. The percentages do not have to add up to 100 i.e., lower values may be set, to exclude some assets from the calculation. However the values for years 1 and 2 must not exceed 100. Gifts are included as actual values for food (as kcal) and cash. Access to wild foods is given as a percentage of the annual food requirement of the household that it is estimated can be met from this source. In most locations this will be at most 5%, but there are locations where this is still a substantial food reserve.

Additionally, the model can be operated 1) with income "expandability" turned on or off (by entering an X); or 2) including or excluding the purchase of nonfood items, i.e., if the box is checked (X), any cash available in that month will be spent first on nonfood expenditure, and only if cash remains will this be spent on food. If the box is unchecked, no nonfood expenditure occurs. Additionally, the percentage of nonfood purchase can be varied.

Model output appears at the bottom of the spreadsheet as three graphs, showing the proportion of household food needs obtained from food production and other food income for each month over the two-year period. The richest two wealth groups (whose food access is often unaffected by crisis) are combined in a single graph. The reference values are shown for each of the two years to show the change in food access.

The graphs show a three-year moving average. This better approximates reality, as in fact people can anticipate seasonal shortages and can to some extent ration themselves to smooth consumption.

An example of the model output is given in figure 22, which shows monthly food access for the very poor wealth group, with the settings set to the reference values (i.e., all food and cash income values to100%, maize and bean price of K10.00/kg and K80/kg respectively for both Year 1 and Year 2, the "Enter X to force purchase of nonfood items before food" box checked and the "Percent nonfood items to be purchased" set to 100%).

Note that in this case households cannot meet their food requirement in the period January–March as income in this wealth group, after the full cost of nonfood goods has been met does not allow sufficient cash to purchase food in that period. Reducing the percentage of nonfood goods to be purchased to 60% allows the full food purchase requirement to be met.

Note that the fall in food access in the January–March period is greater as any cumulative deficit at the end of year 1 is passed on to year 2 (See footnote 1).

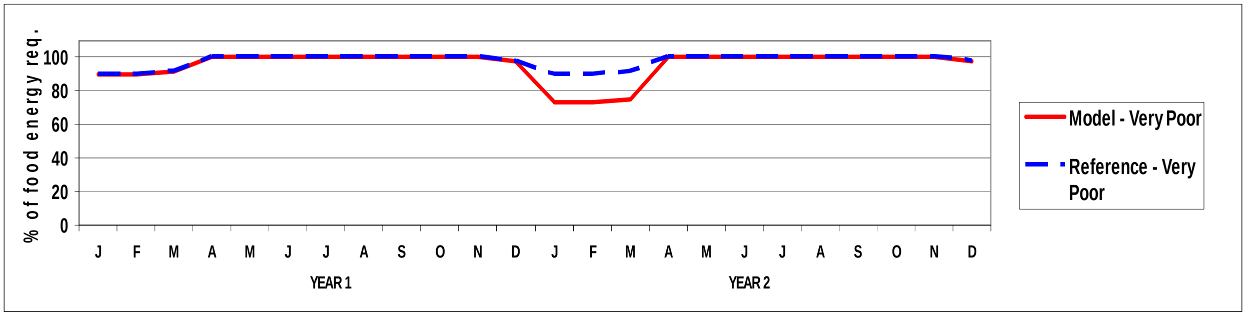

Figure 22. Example: Output for the "very poor" wealth group, with the settings at reference values.

6.3.5 Example: Developing a food security narrative

The following example is based on the Malawi example described in box 8. That is, a shock of a fall in maize production due chiefly to waterlogging and a sharp rise in the maize price. Nutritional status data was gathered in December, just before the harvest, and found a rate that was not untypical for the season. The data used (supplied with the spreadsheet) is from a village in Salima that was affected by this shock.

The aim is to develop a narrative of how crop failure has affected people's food access and to use this to explain the measured nutritional status.

Figure 21 shows the pattern of food and cash income for the three wealth groups in the area. The principle economic activities are from crop (maize, cotton, pulses). The poorer groups depend heavily on seasonal agricultural labor. The better-off are chiefly defined by an involvement in skilled work (carpentry, building) and petty trading activities (e.g., the village shop) and the ability to use this income to produce cotton and to afford inputs to improve their cereal yields, the price of farm inputs having risen to high levels.

Note that the average number of people in a very poor household is five, in the poor household three, and five in better-off households. The proportions of the population falling into the poor, middle and better-off wealth groups are 25%, 40%, and 35% respectively. The nonfood items required to maintain a reasonable basic minimum standard of living are shown in table 3 and household assets in table 4.

6.3.6 The analysis

6.3.6.1 The context

In year 1, the year of the shock:

1. Maize production had fallen by 30% from the reference (in the example the proceeding) year that was neither a good nor bad production year.
2. The maize price rose steadily from July reaching 4–5 times the usual value just before the harvest.

3. A nutrition assessment was done in November, just at the start of the main harvest. It found a malnutrition rate of 9.3% among children 6–59 months of age (below –2SD WFH).

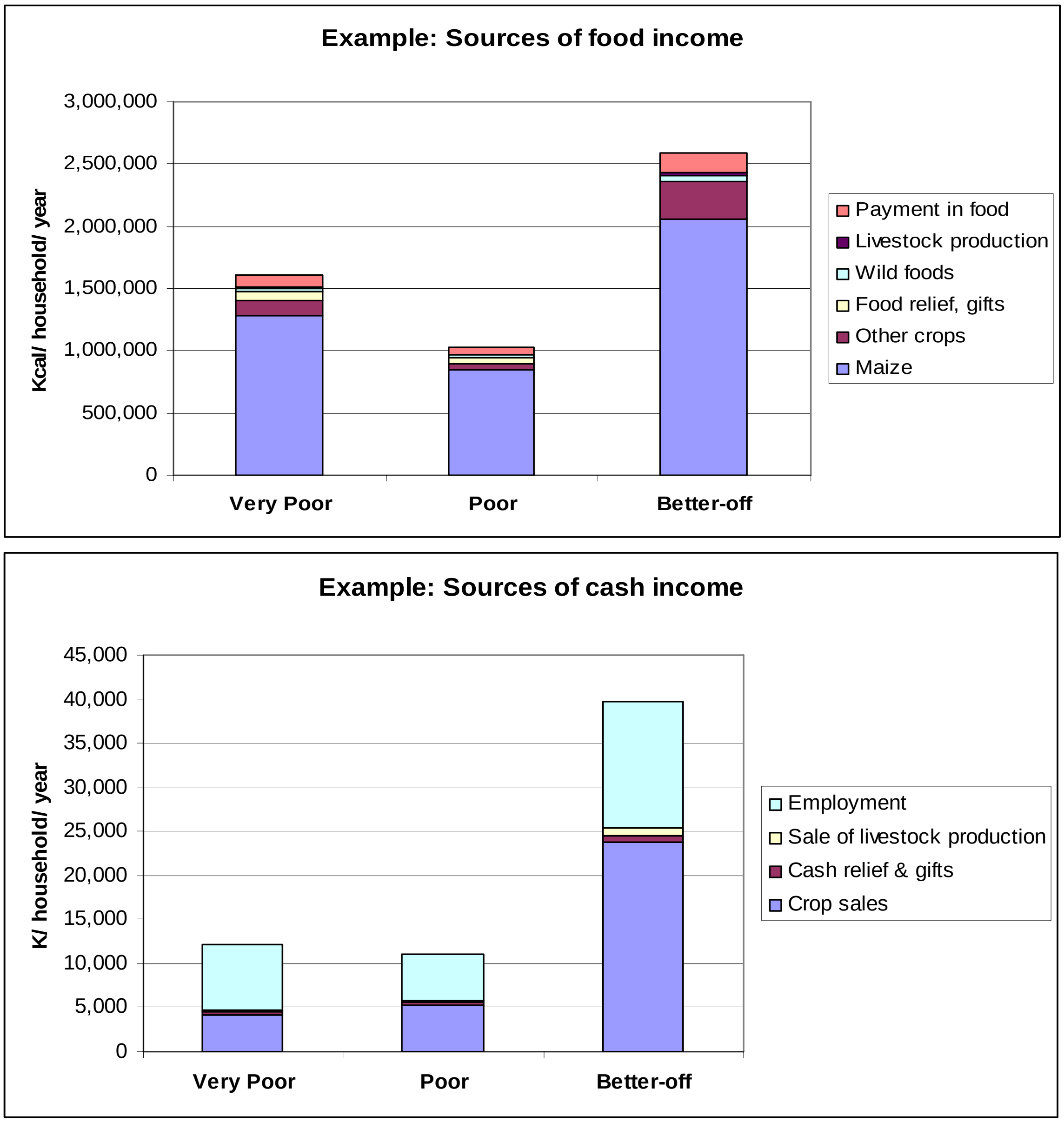

Figure 21. Example: Reference values for household food and cash income

Table 10. Minimum nonfood costs

Item	*Expenditure/yr Malawian kwacha (K)*
Soap	800
Matches	20
Salt	300
Clothes	400
Paraffin	1,000
Utensils etc	250
School costs	350
Water costs	1,000
Total	4,120

Table 11. Household assets by wealth group

	Poor	*Middle*	*Better-off*
Poultry	3	5	10
Goat	0	1	1
Pig	0	1	1

The seasonal spreadsheet has been set out, for each wealth group, with:

- household size and the average energy requirement per person per day; the food energy requirement has been set at 1,800kcal/person/day to approximate that of a poor household in Malawi
- income data and the seasonal percentages.
- minimum nonfood cost (table 10)
- maize/ bean prices set at K10/kg and K 80/kg for the reference year.

Three simulations have been conducted. Simulation 1 shows the impact on food access of the shock, assuming that no coping activities occur. That is, it shows the direct impact of the shock on household food access. Simulation 2 shows the impact on food access of a fall in maize production and a rise in maize price (as in simulation 1), but also assumes that wealth groups attempt to cope by selling assets and taking other steps to make up the deficit. Simulation 3 calculates the quantity of food that would be required to make up the food deficit, given the assumptions in simulation 1.

6.3.6.1.1 Simulation 1

This simulates the impact on food access of the shock assuming that no coping activities occur.

The settings used are

- maize consumption and maize sales reduced to 70% of reference production

- the price of maize (table 12) is set to increase from July in Year 1 to peak at K 45/kg in February of Year 2 to approximate the changes that occurred. For simplicity, the price of beans has been set to K80/Kg for all months and years. The assumption is that after the maize harvest in Year 2, maize prices fall to normal levels.
- food purchases are prioritized over nonfood costs (i.e., the checkbox is unchecked)

Table 12

Maize price

	J	F	M	A	M	J	J	A	S	O	N	D
Ref year	10	8	8	9	10	10	10	11	12	12	12	12
Year 1	14	14	14	14	16	20	23	26	29	32	35	38
Year 2	45	30	20	12	12	12	12	12	12	12	12	12

The result for the very poor wealth group is shown in figure 22. This shows that food access collapses after August/September in Year 1, falling to very low levels in December and January before the harvest in Year 2. The result for the poor wealth group, not shown, shows a more modest fall in food access.

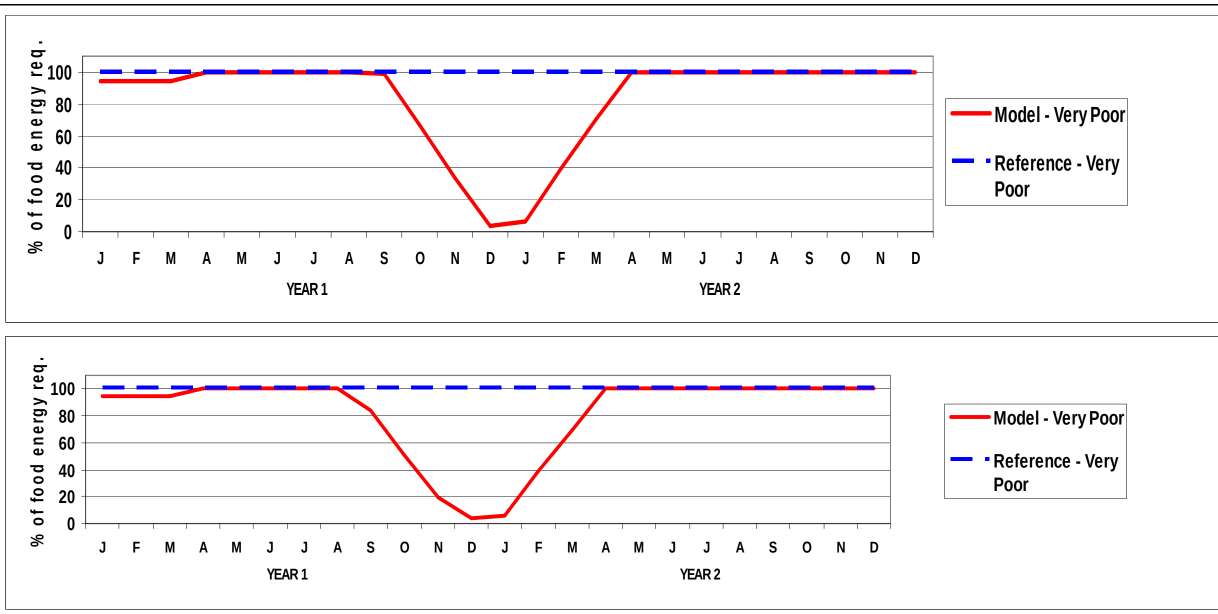

Figure 22. Example: Simulation of the impact of a 70% fall in maize production and a sharp rise in food prices in year 1. Upper graph with no nonfood expenditure; lower graph with 20% nonfood expenditure.

6.3.6.1.2 Simulation 2

This simulation estimates the impact on food access of a fall in maize production and a rise in maize price (as in simulation 1), but additionally assumes that wealth groups attempt to 'cope ' by selling assets and taking other steps to cover the deficit.

The settings used ('Expandability', worksheet 3) are:

- Livestock: 100% to be sold in year 1. As many people are attempting to sell livestock, livestock prices would be expected to fall. In fact, livestock prices fell and maize prices rose to the point where people ate the animals rather than sell them.[55] For illustration, it has been assumed that livestock values are maintained at reference values (poultry K75 each, and pigs and goats approximately K1,500 each).
- Food stocks are set at 100% to be consumed.
- Gift giving between households tends to collapse under these conditions, and this value has been set to zero.
- Wild foods (chiefly seasonal wild fruits and leaves) make up only 0.9% of the reference energy requirement of the very poor group. As it would be expected that demand for wild foods would rise following the shock this has been set to 0.5% of household energy requirement.

In fact, in this case people sold not only livestock but also furniture and any goods for which they could get a price. These have not been factored in to the analysis as their value is so low.

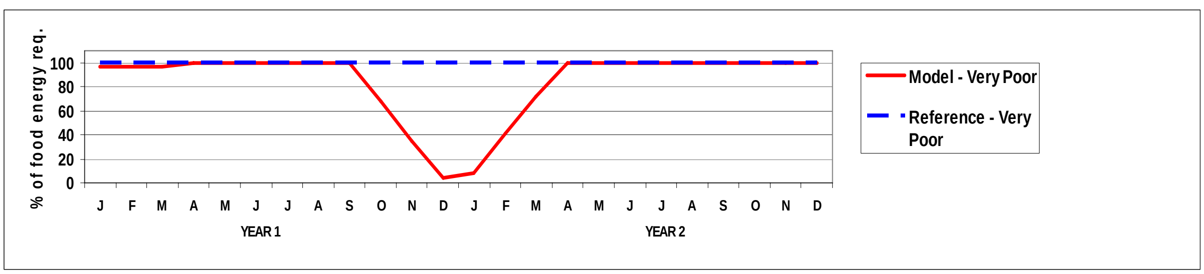

Figure 23. Simulation 2. Simulation of the impact of a 70% fall in maize production and a sharp rise in food prices in year 1, using all coping strategies and assuming no nonfood expenditure.

Figure 23 shows the simulation result, assuming no nonfood expenditure. This suggests that for the very poor wealth group, the use of all their reserves, even making optimistic assumptions about the value of these is very small i.e., compare the result with the upper graph in Figure 22.

[55] This could be factored in by calculating the energy value of a goat and adding this to the 'gift' section.

6.3.6.1.3 Simulation 3

Other statistics can be derived from the model. For example assuming that some population statistics are available the quantity of maize required to make up the deficit can be calculated by:

- setting a value for nonfood expenditure i.e., a value that is thought under the circumstances to be commensurate with an acceptable standard of living (50% has been entered)
- setting the coping box to X.
- adding values to the food gift section until food access in year 1 approximates the reference value (in this case for the very poor group, approximately 1,000,000kcal would be required, or 275kg of maize)

The number of households in this village was 211, i.e., the very poor group (52 households), suggesting a deficit equivalent to approximately 14 tons.

6.3.6.2 Projecting forward from the nutrition survey

In planning a relief intervention, it is necessary to predict what is going to happen to people's food access. This requires an estimate of what is likely to happen to

1. each income source over the coming year
2. the price of traded goods and services
3. possible additional income from government/national and external intervention, e.g., food aid

It is impossible to estimate these with complete confidence. Nevertheless it is possible to make well-informed judgments.

1. Take each income source in turn and ask if there are any local implications of the current situation that would argue for a change in income from that source in the coming year. Discussion with local key informants is usually the best guide to this. For example, income from crops and local agricultural/unskilled employment may fall. In the Malawi case, much unskilled labor outside the agricultural season is found in house building for the better off groups—an activity that occurs only in years when income is good. In the year following a crisis people, including the better off, may have difficulty in finding the resources to meet the cost of farm inputs (fertilizer/pesticides and labor).
2. Where a crisis has had a wider national or regional impact, work and trading opportunities may fall in a wider area that will reduce employment opportunities, e.g., on plantations, in cities, and for some, goods and services provided to the poor.
3. Some assessment must be made of the likelihood of government/national and external intervention and when and how this will occur. For example, in Malawi, it was clear at the time of the nutrition assessment that food aid in substantial quantities would not be available for several months. Malawi is landlocked, and food would have to be imported and transported over long distances.

Uncertainties will remain; for example, it cannot be known if rainfall will be adequate in the coming year. In cases where there is doubt about factors that may have a major impact on household economy, more than one scenario can be developed using different values for each. This allows a range of possible outcomes to be developed and alternative and fall-back interventions developed for each.

6.3.7 Connecting the food security analysis and nutritional survey findings.

It is not possible to draw a precise connection between household food access and nutritional status, e.g., that a fall in food access to X% of usual consumption for a given period will lead to a Y% change in children's nutrition status. It is not known how food is distributed within the household, and even if this were known, not enough is known about individual requirement to make precise calculations. Nevertheless, it would be expected that large changes in food access will be followed by changes in population nutritional status, particularly for the poorest people. These groups already have low energy intakes, low biological reserves and often suffer seasonal falls in food access even in non-crisis years. Trends in food access can therefore provide a good general guide to the way in which nutritional status will evolve.

7 Interpretation and recommendations

This section will be completed in Version 2, based on the experience of implementing Version 1.

8 Appendices

8.1 Example measurement standardization test forms

First measure:

Enumerator name…………. ID ### *1st measure*		
Child	Weight (Kg)	Height (cm)
1	14.6	96.0
2	10.3	89.8
3	13.8	105.1
4	11.1	84.5
5	10.8	89.3
6	9.4	76.3
7	10.3	87.6
8	14.3	101.1
9	8.0	74.3
10	15.6	97.0

Second measure:

Enumerator name…………. ID ### *2nd measure*		
Child	Weight (Kg)	Height (cm)
1	14.8	96.1
2	10.4	89.5
3	13.8	105.3
4	11.0	84.7
5	10.7	89.0
6	9.4	76.4
7	10.3	87.6
8	14.1	101.2
9	8.1	74.1
10	15.4	97.5

8.2 Energy values of foods

This summary table of food energy values has been extracted from *Tables of Representative Values of Foods Commonly Used in Tropical Countries* (Platt, 1985). The table is useful for evaluating dietary data based on records of group consumption. The tables are not suitable for detailed surveys of the diets of individuals. Food energy values are given as the amount per 100 g of edible portion.

CEREALS	
1. Barley, whole, de-husked	339
2. Barley, pearled	351
3. Buckwheat flour, 90% extraction	348
4. Buckwheat flour, 60% extraction	349
5. Maize, whole	363
6. Maize meal, about 96% extraction	362
7. Maize meal, refined, 60% extraction	354
8. Maize starch (commercial), corn-flour	352
9. Millet, bulrush, whole grains	363
10. Millet, bulrush, meal	365
11. Millet, finger, whole grain	336
12. Millet, finger, meal	332
13. Millet, haraka, de-husked	353
14. Millet, jajeo, de-husked	355
15. Millet, various, de-husked	355
16. Quinoa	345
17. Oats de-husked	388
18. Rice, lightly milled and parboiled	354
19. Rice, highly milled, polished	352
20. Rye, 85-90% extraction	350
21. Sorghum, whole grain	355
22. Sorghum flour	353
23. Teff, whole grains	345
24. Wheat, whole and parboiled	344
25. Wheat flour, 85% extraction	346
26. Wheat flour, 70% extraction	350
STARCHY ROOTS, TUBERS AND FRUITS	
27. Arrowroot flour	340
28. Breadfruit pulp	113
29. Cassava, fresh	153
30. Cassava flour	342
31. Ensete	190
32. Plantain	128
33. Potato, Irish	75
34. Potato, Sweet	114
35. Sago flour	352
36. Taro	113
37. Yam, fresh	104
38. Yam flour	317
39. Yam bean tuber	41
OIL SEEDS AND NUTS	

40. Almond	657
41. Brazil nut	688
42. Cashew nut	590
43. Coconut, kernel, mature, fresh	375
44. Coconut, kernel, immature	125
45. Coconut milk, ripe nut	14
46. Dika nut, kernel dried	697
47. Karkashi	615
48. Niger	513
49. Oil bean, whole seed	544
50. Pistachio nut	626
51. Pumpkin seeds, seed coat removed	610
52. Sesame seeds	592
53. Sunflower seeds, seed coat removed	524
54. Walnut	697
GRAIN LEGUMES AND PRODUCTS	
55. Bambara groundnut	367
56. Bonavist bean	351
57. Chickpea	368
58. Cowpea	340
59. Fenugreek	335
60. Goa bean	404
61. Groundnut, dry	579
62. Groundnut, fresh	332
63. Horse bean	342
64. Horse gram	338
65. Kidney bean	339
66. Lathyrus pea	293
67. Lentil	339
68. Lima bean	326
69. Locust bean	380
70. Mung bean (black)	329
71. Manga bean (green)	324
72. Pea	337
73. Pigeon pea	328
74. Scarlet runner bean	326
75. Soya bean seed	382
76. Soya bean milk	32
77. Soya bean curd	76
78. Soya bean	363
79. Tepary bean	331
80. Velvet bean	351
VEGETABLES	
81. Beans, eaten green in pod	34
82. Beans and peas, fresh, shelled	104
83. Bean sprouts	28
84. Beetroot	45
85. Carrots	33
86. Cucumber	12
87. Eggplant	22
88. Gourd	28
89. Leaves, high carotene, dark green, e.g., Spinach, pigweed, sweet potato tops, kale, bledo, etc.	48

90. Leaves, medium carotene, e.g., chard, New Zealand spinach, purslane, cassava leaves, watercress, cress, squash, pumpkin, colza, etc.	28
91. Leaves, low carotene, pale green, e.g., cabbage, kohirabi, Chinese cabbage, etc.	23
92. Leek	52
93. Maize, immature on cob	123
94. Okra	33
95. Onion and shallot	48
96. Palm cabbage shoot	34
97. Peppers, sweet green and red, seeds removed	37
98. Pumpkin, squash and vegetable marrow	36
99. Radish	18
100. Tomato with skin	20
101. Turnip and swede	34
FRUITS	
102. Avocado pear	165
103. Banana	116
104. Cape gooseberry	48
105. Cashew apple	56
106. Citrus, grapefruit, pommelo, etc.	37
107. Citrus, lemon and lime	36
108. Citrus, orange and tangerine	53
109. Custard apple, soursop, sugar apple	93
110. Dates, dried	303
111. Fig, fresh	49
112. Fig, dried	269
113. Grape	76
114. Grenadilla, flesh and seeds	92
115. Guava, flesh and seeds	58
116. Hog plum, Spanish plum	95
117. Kanapy, flesh	74
118. Mammy apple excluding seeds	49
119. Mango	63
120. Melon, sweet	26
121. Melon, water	23
122. Palm fruits, peach palm, pejibay	209
123. Papaya	39
124. Pineapple	57
125. Plum	45
126. Pomegranate pulp	77
127. Prickly pear, pulp and small seeds	56
128. Star apple	82
FATS AND OILS	
129. Butter	745
130. Fish liver oils	900
131. Ghee	828
132. Lard and other animal fats	891
133. Margarine	765
134. Red palm oil	900
135. Vegetable oils	900
INSECTS AND LARVAE	
136. Lake fly	289
137. Larvae, dried caterpillars	372

138. Locusts, mature	134
139. Termites, mature	148
BEVERAGES	
Beer, sorghum	35
Beer, European	35
Palm wine (1/2-1 day fermentation)	17
FISH AND FISH PRODUCTS (INCLUDING MOLLUSCS AND CRUSTACEA)	
Fish, freshwater, fillet	95
Fish, sea, lean fillet	73
Fish, sea fat filet	166
Cod, salt	125
Fish, dried	309
Crustaceans (lobster, crab, prawns, etc.)	94
Mollusks (oysters, mussels, clams, etc.)	70
Sardines, canned in oil	309
Salmon, canned	170
Snail, river, pond	82
Turtle	79
SYRUPS, SUGARS AND PRESERVES	
Honey	286
Jam	260
Molasses (cane, medium)	276
Sugar, crude brown	389
Sugar cane juice	73
Sugar, white	400
CONDIMENTS, SPICES, FUNGI, MISCELLANEOUS	
Cola nut	350
Maize and sorghum stems	58
Sugar cane stem	60
Fungi, mixed, fresh	11
Fungi, mixed, dried	99
Mushrooms, fresh	13
Chilies, hot, dried	291
Garlic	139
Tamarind	304
Mustard seed	544
MEAT, MEAT PRODUCTS AND EGGS	
Bacon fat, whole side	589
Bacon, lean, whole side	362
Beef, moderate fat, whole carcass	262
Beef, lean, whole carcass	202
Beef, canned, corn	227
Eggs, hens and ducks	158
Goat, carcass	142
Mutton, fat, whole carcass	412
Mutton, moderate fat, whole carcass	249
Mutton, lean, whole carcass	149
Offal, heart	129
Offal, kidney	127
Offal, liver	136
Pork, fat, whole carcass	535
Pork, lean, whole carcass	371

Pork, salt, fat	781
Poultry, chicken, duck, turkey, etc.	139
Rabbit	134
Veal, moderately fat	184
MILK AND MILK PRODUCTS	
Cheese from whole cow's milk, hard	384
Cheese from skimmed cow's milk, soft	87
Milk, cow, whole	64
Milk, human	75
Milk, buffalo	102
Milk, goat	71
Milk, sheep	108
Milk, cow, skimmed	34
Milk, cow, whole, condensed	140
Milk, cow, whole, condensed, sweetened	317
Milk, cow, whole, powder (unmodified)	500
Milk, cow, skimmed, condensed, sweetened	276
Milk, cow, skimmed, powder	357

Appendix 2[56]

FSAU/FAO SOMALIA: MODIFIED **MORTALITY SURVEY QUESTIONNAIRE**

Enumerators Name: ___________________ Team No: _____________ Date: ______________

Household No: _________ Cluster No: ________ District: ______________ Village: ____________

No.	**1**: Name	**2**: Sex	**3**: Age (yrs)	**4**: Born since 1st March 2005	**5**: Arrived since1st March 2005	**6**: Reason for leaving	**7**: Cause of death
a) How many members are present in this household now? List them.							
b) How many members have left this household (out migrants) since 1st March 2005? List them							
c) Do you have any member of the household who has died since 1st March 2005? List them							

Summary*

	U5	Total
Current HH Members		
Arrivals during the Recall period		
Number who have left during Recall period		
Births during recall		
Deaths during recall period		
Number of HH members at beginning of recall		

** For Supervisor Only*

[56] See NutriSurvey software for additional examples of questionnaires.