Bioversity International

Improving nutrition with agricultural biodiversity

A manual on implementing food systems field projects to assess and improve dietary diversity, and nutrition and health outcomes

Bioversity International undertakes, encourages and supports research and other research based activities on the use and conservation of agricultural biodiversity to create more productive, resilient and sustainable harvests. Our aim is to promote the greater well-being of people, particularly poor people in developing countries by helping them to achieve food security, to improve their nutrition and health, to boost their incomes and to conserve the natural resources on which they depend. The organization is active in over 100 countries worldwide, with more than 300 staff working from some 20 offices. It is one of the 15 Centres of the Consultative Group on International Agricultural Research (CGIAR). Bioversity's headquarters are located in Maccarese, Italy just outside of Rome. Bioversity staff includes specialists in agriculture, nutrition, food science, forestry, information science and technology, communications, socioeconomics, law and policy, finance and administration.

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Section 1: **Introduction**

1.1 Importance of agricultural biodiversity:

While the positive relationship between biodiversity, dietary diversity and health seems clear but based on anecdotal evidence, there is a pressing need for this relationship to be confirmed based on empirical evidence. Solutions to addressing the growing challenge of global malnutrition depend on innovations in policy and practice. Historically, dietary interventions have focused primarily on protein and calories, later on minerals and vitamins, and most recently on functional and healthful properties of foods, such as anti-oxidants. In each of these cases, a focus on single components within foods has frequently neglected the foods themselves as they fit into a food system and socio-cultural context. One important component missing from many complementary strategies aimed at scaling up nutrition interventions is agricultural biodiversity, also called agrobiodiversity, which applies a food systems approach to intervention strategies.

Agrobiodiversity within food systems not only provides a wide and varied range of nutrient-rich foods and dietary components with important health properties, it is a resource that is locally available; it is the basis of dietary diversity, the preferred choice for nutrition and health. Furthermore, because agrobiodiversity links to communities' food culture, traditions and practices, it can reinforce the cultural and social determinants of wise food choices by individuals that are fundamental to the good health of the population.

Bioversity International's food and nutrition initiative stresses a holistic approach to food and nutrition interventions, which involves the mobilization of the

agricultural biodiversity of traditional food systems to ensure dietary diversity, improved nutrition and health. There is increasing consensus among health care professionals and international development specialists that dietary energy needs can be met without dietary diversity but micronutrient needs cannot be met without diversity. Bioversity International is involved in systematic research to assess the diversity of diets of vulnerable communities, especially in regions that are prone to food and nutrition challenges. To date, much of this research has resulted in positive outcomes for communities where the research has been piloted.

1.2 Intended readers:

This manual is aimed at Bioversity's national and regional partners and humanitarian organizations with interests in the impacts of agrobiodiversity on food availability, nutrition and health in developing countries. It is a practical tool that can be used by field workers trained in agroecology and home survey data gathering techniques, as well as experienced health and agriculture professionals. The guidelines, provided in this manual, combine traditional and scientific knowledge and can be applied to local communities.

1.3 Purpose of this manual:

While a growing body of data and reports demonstrate that there exists a wide variety of diverse traditional foods and that these traditional, locally-sourced, foods are rich in micronutrients and bioactive health protecting and promoting compounds, available information is still insufficient and too incomplete to make a difference in nutrition programming on a global scale or to influence relevant national policies. Also the existing nutrition-related data on biodiversity-sourced foods are not available in comparative frameworks using standardized methods and protocols. This makes it difficult to verify and determine specific ways that biodiversity contributes to meeting existing nutrition goals and targets in a range of contexts.

Field staff on community nutrition should aim to provide strong and robust evidence of the relationships between agrobiodiversity and dietary diversity on nutrition and health status of communities who consume the foods. This manual outlines a systematic and credible process in documenting all stages of research into such relationships in a manner that is replicable.

Information on agroecology, foods and nutrition can be gathered using both quantitative and qualitative research methodologies. Quantitative approaches yield data on food availability and nutrition status through questionnaire use and measurements. Qualitative methods, on the other hand, provide information collected through individual or group interviews and observations. Qualitative research explores, discovers, and asks why, how and under what circumstances the actual statistics are generated. This use of both approaches, a practice known as triangulation, is required to develop a useful understanding of the food and nutrition situation in any population.

The findings of quality research must be applied, meaning that analyzed data will be used to design community appropriate interventions targeted at filling the gaps discovered in the course of the study. By developing detailed knowledge of their communities of research, NGO's and Biodiversity International gain the ability to give relevant recommendations as well as provide the infrastructure and personnel support necessary to improve nutritional status through increasing dietary diversity. It is paramount that the research findings be directly utilized for further assisting the

communities in which the data was collected in their development process. Associating recommended agronomic practices and nutritional behaviours in the home with each other help bridge the gap between the agricultural and nutritional perspectives on development, creating a more holistic understanding of the health implications of local food system improvements.

There has been a growing need to broadly standardize food and nutrition protocols among Bioversity staff and partners across the regions for comparability of results and generally to strengthen the quality of the surveys. This idea came out strongly during a workshop organized in 2007 in Nairobi to harmonize food and nutrition survey protocol that will be used by Bioversity and its partners. The guidelines proposed in this document are therefore a culmination of the discussions and recommendations of that meeting.

1.4 What the manual contains:

This guide describes the process and procedures for collecting important information required to assess local farming systems and agrobiodiversity, household food consumption norms and the nutritional status of vulnerable groups within a given population using specific indicators. Additionally, this guide provides a framework for practical implementation of a holistic program that focuses on creating a customized intervention based on community-specific data. The manual strives to combine perspectives from the following models and approaches:

1. Farming Systems Model (FAO/WB)
2. Agroecological Model (NAFRI, FAO)
3. Indigenous Food Culture Documentation (CINE/IDRC/FAO)
4. Measuring Nutritional Functional Diversity (Columbia EI)
5. Positive Deviance Model (The Positive Deviance Initiative)
6. FANTA Nutritional Assessment Guides (USAID)
7. Food Security and Livelihoods Model (ACF International)
8. Ethnobotanical Documentation: A User's Model (ICH/UNESCO)

The development of this manual also could not have been possible without the guidance of previously published manuals by the World Health Organization (WHO), the World Food Programme (WFP) and the Centre for Indigenous Peoples' Nutrition and Environment CINE.

This manual recommends a 7 phase process to approach communities of focus holistically and with a trajectory of long-term improvement.

The recommended process is a follows:

Phase 1: Program Design and Preparation
Biodiversity International works with local partners to find communities fitting nutrition strategy foci. A general list of research objectives are included. Baseline data is collected from relevant sources, and program facilitation staff are hired and trained in agronomic, nutritional, and ethnofood data collection techniques, as well as rapport building and community development facilitation.

Phase 2: Developing the Macro-perspective:
Understanding Agroecology and Ethnofood Culture

Project Facilitators use focus group and key informant interviewing to construct a broad view of community baseline circumstances and potentials through collection of food culture, ethnofoods, and agroecosystem data sets. Food composition measurements of collected specialty variety

ethnofood samples, as well as known nutritional values of other foods consumed are used to assign a level of Nutritional Functional Diversity to the community.

Phase 3: Assessing Food Security and Nutritional Status at the Household Level
Project Facilitators do household surveys of sampled homes, taking anthropometric measurements of all family members, a 24 hour food recall coupled with HDDS and MAHFP scales, and general socio-demographics to assess potential access to improved food security.

Phase 4: Data Analysis and Baseline Study Report Writing
Both qualitative and quantitative data should be systematized and visualized to create a functional understanding of community food security, nutritional status, and agrobiodiversity and their correlations to each other, if any. A set of recommendations should be developed based on this data to use in the intervention design phase. Additional information can also be collected if deemed necessary to the development of a clear representation of community circumstances.

Phase 5: Intervention Design
Collaboration of agriculture, nutrition, and anthropology/sociology consultants along with the program director, manager and facilitators and the community itself to craft a holistic approach to address gaps and promote successes in food system development and usage. A variety of types of interventions that address community needs from multiple perspectives can be combined to maximize nutrition improvement potentials.

Phase 6: Intervention Roll-out and Assessment:
Implementation of the approach designed in Phase 5 according to community appropriate methods and timings, with regular evaluation to correct for ineffective strategies, and to bring fresh insight to approaches as they develop in the field.

Phase 7: Final Evaluation of Intervention Efficacy
According to project management recommendations, duration of the project should be allocated based on giving ample time for local capacity development and adoption of new practices for long-term sustainability. Regular reporting about project process lends insight into the appropriate timings for staffing phase-out at the local level, as well as the potential necessity for more permanent infrastructural support. Data about community changes and improvements should be carefully documented and compiled into a final report, fully discussing successful approaches, failures, and challenges in the intervention process.

Tools to use:
There are several nutritional assessment tools that can be used in population studies in order to empirically establish the relationships between agricultural biodiversity, the consumption of diversified diets and health outcomes. The main methods designed for data collection, which have been tested in various projects and require collecting data directly from individuals and community members are:

1. Agroecology/Farming Systems Documentation: Cropping systems, seasonality of production, and availability of resources all interact with market and cultural structures within communities to affect food security of the community. Creating a picture of agro-ecosystems at the village level as well as the food-shed as a whole through mapping of farm systems and market flows of agricultural products helps to correlate the landscape of food production with food security perspectives.

2. Food Culture and Ethnobotanical Cataloguing: The key to understanding potential for improving agrobiodiversity for health is developing a complete picture of the nutritional value of available consumables in the given community. This includes sets of questions related to cultural food decision making and eating behavior in homes, as well as folk taxonomy and growing season cataloguing of locally available traditional foods.

3. Dietary, Health and Socioeconomic Questionnaires: This is the main instrument for survey research and includes standardized socio-economic and health-related questions. Information gathered contributes to the researcher's understanding of household food security as correlated to health, food intakes, income, education levels, and many more factors.

4. Anthropometry Measures: This measure assesses changes in body measurements over a time frame that can be used to determine nutritional status of individuals compared to a reference mean. It can also be used to determine the presence of malnutrition in a surveyed population. It is widely used, inexpensive and a non-invasive assessment. The main building blocks of anthropometry are age, sex, weight, height or length and oedema. Combined, these building blocks - commonly referred to as indices - provide valuable information on an individual's nutritional status.

5. Food security/insecurity measures: Food security is the interrelationship of food supply accessibility, availability, and stability, as well as utility which includes the cultural norms that govern food usage on the household and community level and availability of other resources, such as firewood or clean water, which affect preparation choices. Food security is measured by household dietary diversity (HDDS) and months of adequate household food provisioning (MAHFP).

6. *Optional Biochemical Measures: This measure assesses changes in the contents of specific components in body fluids. Micronutrient deficiencies represent a less visible form of malnutrition. To assess micronutrient deficiencies, blood or urine is collected for biochemical analysis of iron, zinc and vitamin A for instance. While valuable, the collection, transportation, and testing of blood samples is both a delicate and costly process. A nutritional agro-biodiversity study need not necessarily include these measures, unless relevant inferences about micronutrient intakes cannot be made from existing food composition data and dietary intake surveys.

Section 2:

How to Plan and Implement a Nutritional Agrobiodiversity Project

Phase 1: Planning and Preparation of Research

2.1.1 Defining objectives:

Before starting any research, objectives must be precise and clear. This enables the research team, collaborating organizations, and the study population to understand the aims of the study and also facilitates data analysis (Webb and Bhatia, 2005).

There are currently 3 main categories of studies relevant to dietary research:

1. Diagnostic or situational studies

2. Testing relationships or hypotheses / Epidemiological studies

3. Assessing interventions / Impact analysis studies

Diagnostic or situational studies are generally concerned with understanding the prevalence of problems and understanding patterns. They may be carried out to identify and prioritize problems and people that need attention. They may form the basis of designing interventions and prioritizing objectives. These studies may also be used in an exploratory sense to develop hypotheses for later evaluation.

Epidemiological studies, aimed at testing relationships and hypotheses, generally attempt to prove causal relationships between factors. Examples of this would be determining the

determinants of dietary behaviour, or understanding the relationships between dietary patterns and health outcomes.

Impact assessment, or the assessment of interventions in complex real-life situations, is concerned with estimating the effect of a given intervention or combination of interventions on a given problem or target population. It is also concerned with estimating the extent to which these conclusions can be extrapolated.

This manual focuses on bringing together these three through first gaining a macro perspective on community issues to correctly describe successes and gaps, and then testing relationships between agrobiodiversity, diet and nutritional status. Interventions will then be based on both descriptive and comparative findings, and the impact of the intervention can be evaluated at intervals to determine efficacy and applicability to future work.

Development vs. Research

Researchers need to consider the balance between depth and breadth of a study, weighing the complexity of the question versus the breadth of applicability. This determines the applicability of the results obtained through the study. Is the focus narrow aimed exclusively at the community of involvement, or is research focused so that results have the broadest possible applicability? More complex issues may benefit from a case study approach, which may provide better understanding of mechanisms involved in causal relationships, but often provides limited proof of the relationship and says little of the breadth of applicability of the findings. Biodiversity International intends the framework of this manual to be used to target the needs of specific communities in a customized way, while at the same time utilizing the successful strategies discovered to create a framework for future interventions and approaches.

The following research questions are central to Biodiversity International's Nutrition Strategy:

1. How does agricultural biodiversity on-farm contribute to household consumption and to dietary diversity and quality?

2. How can we link agricultural diversity to improved nutrition and health outcomes and benefits and does it make an impact?

3. Can agricultural biodiversity be scaled for commercial use while maintaining biodiversity and ecosystems and improving human health?

4. What does agricultural biodiversity imply for peri-urban and urban markets, and what do trends in urban markets imply for potential success of agricultural biodiversity?

5. How can we better use and promote local knowledge of agricultural biodiversity to improve the health of households?

6. What new tools and methodologies can be created and validated that measure agricultural biodiversity associated with dietary patterns?

A nutrition and agro-biodiversity program seeking to answer these research questions can be guided by the following objectives with the option to tailor each objective to meet unique community circumstances.

Research Objectives:

1. Create an accurate and detailed report of all products cultivated, gathered, raised, or caught

in the area of study that are edible or edible and consumable.

2. Use the agroecology method to visualize agronomic systems, land ownership, available natural resources, market flows, and infrastructures existing in the focus community.

3. Assess socio-cultural attitudes about food, including care and feeding techniques of children, food allocation in the home, food taboos, folk taxonomy of food properties, typical or representative foods, and cooking techniques.

4. Compile food composition information of the majority of foods included in the community's food system and assess functional diversity according to nutritional values.

5. Measure nutritional status of households using anthropometric methodology.

6. Understand socio-demographics and household food security as related to nutritional status.

7. Design and implement an intervention that promotes agro-food behaviors associated with better nutritional status as observed in positively deviant households and advocates for shifts in agronomic practice, dietary decisions, and/or food culture practices to improve nutritional status.

8. Evaluate efficacy of the intervention at regular intervals, making adjustments to improve outcomes and efficiencies as problems arise.

9. Document both successes and failures in approach to inform future intervention design decisions.

2.1.2 Defining the geographic target area:

Commonly, the area where the survey is to be conducted is a governmental administrative area such as a district or province or a community within these administrative divisions. Ideally, the area chosen should consist of a population with a similar nutritional situation in order to obtain a reliable perspective. In cases of different nutritional statuses, the results would represent an average measure for the entire nation (Webb and Bhatia, 2005).

The target area is normally decided through rapid assessment, key informant interviews, and visiting clinics and hospitals to determine areas of need. Once a decision has been made, a report consisting of a map should be developed. This map should include areas that cannot be accessed due to insecurity, and therefore reported as excluded from the survey (Golden, 2006).

2.1.3 Defining the population group:

Different population groups could be used as targets for the study of nutrition status within a wider population. The selection of appropriate target groups depends on such factors as the purpose of the study, nutritional indicators of interest, vulnerability of the target groups to nutritional deficiencies of interest, how representative such groups are of the larger population, and accessibility of such groups for assessment during the study period.

Quite often population groups that are easily accessible for periodic assessments may facilitate surveillance and reduce logistical costs. However these specific population groups may not be adequately representative of the general population and so extrapolating results from these sub-groups to the general population needs to be done with caution.

The following population groups have been selected as the targeted communities in Bioversity's nutrition strategy:

1. Our Most Vital Asset: Women
Women produce 60-80% of the food that is consumed locally in developing countries (Nagayet 2005; World Bank 2009). Women are the keepers of food culture in their communities, and play a vital role in conserving and using biodiversity in their farming systems (World Watch Institute, 2011). Non-staple minor crops as well as animal husbandry offer opportunities for value addition and can increase income security for women (Herforth 2010).

2. Rural smallholder farmers in the developing world.
At least half of the world's food-insecure people are smallholder farmers living in poverty. Many of these farmers are women, who are disproportionately poor and vulnerable to malnutrition, which affects not only themselves but their children as well. Although women and children remain the most vulnerable to the consequences of malnutrition, beneficiaries of our work will include entire smallholder household families.

3. Populations living in urban and peri-urban settings without access to diversity.
With the world's population expected to grow significantly in the next 30 years, and many more people migrating and living in urban centres, there will be a need to increase quality food production both nutritionally and environmentally, and to ensure that food distribution and access is more equitable. Sustainable practices complemented with increased productivity, or sustainable agricultural intensification complemented with improvements in nutritional quality of foods, will need to be considered with the growing needs of the global urban population. Working with private sector and value chain actors will be essential to ensure that peri-urban and urban consumers have access to affordable foods coming from agricultural biodiverse food systems.

4. Communities at risk of traditional food system loss.
These communities have developed a subsistence base derived from the natural resources available from specific ecosystems. Some of these ecosystems and traditional food systems are threatened or in transition. These beneficiaries, including farmers, pastoralists, forest communities and fisher folk, are some of the most nutritionally vulnerable to the global food system, particularly in poverty stricken, food-insecure communities.

2.1.4 Organizing the research team:

A research team is made up of many members whose various contributions are mutually supportive of each other but which can, on the other hand, be counter-productive if the team is not put together with the careful planning and sequencing it deserves. In view of the uniqueness of Bioversity's goals in nutrition research for agro-biodiversity, the following set of staff members are recommended to design and implement the research and intervention:

1. *Program Director:* hires and manages staff, maintains organizational presence in a well located office, liaises with donors, writes and edits reports and publications related to the project.

2. *Project Facilitator Manager:* oversees training and job performance assessment of project facilitators, , visits field sites to monitor and evaluate data collection and intervention roll-out to ensure that goals are met, enters and processes data in the office database.

3. *Agro-botanist*: trains project facilitators in ethno-foods data collection techniques, identifies and categorizes collected samples, oversees food composition lab testing of all collected samples, makes recommendations regarding specific species or families of plants to target in the intervention design.

4. *Agronomist:* trains project facilitators in soil and GPS data collection techniques, categorizes farming system, helps facilitate focus group discussions to visualize the local agroecosystem, makes recommendations on any agronomic and farm livelihood changes promoted in the intervention.

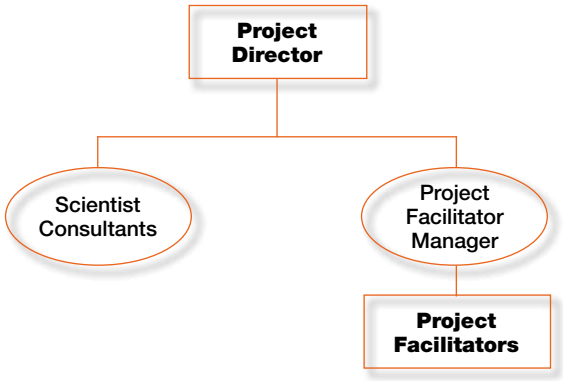
5. *Nutritionist*: trains facilitators in anthropometric and food security indice data collection, assesses dietary adequacy, makes recommendations about what food groups should be promoted for increased consumption.

6. *Anthropologist/sociologist*: trains staff in interview techniques, cultural observation strategies, assists in field data collection of food culture information where necessary, helps develop culturally appropriate interventions.

7. *Project Facilitators*: At least 2 per location: collect all data for the initial project baseline study at both the household and community levels, participate in the intervention design process, roll-out the intervention according to team recommendations and procedures, monitor progress of intervention through community interaction, and help evaluate successes and failures to routinely adjust intervention strategies.

8.* Optional *Local Guides/ Interpreters*: If Project Facilitators hired are not fluent in the language of the area of study, a person from the area can be hired as a guide for the Project Facilitators. The ideal situation is to hire individuals with language capacity for the area directly as Project Facilitators, as it serves the dual purpose of developing local capacity as well as removing an additional channel through which information travels, thus decreasing the potential for mistakes in data recording.

The staff hierarchy is intended to function in the following way:



2.1.5 Meeting with community leaders and local authorities:

Before starting the survey, it is crucial to meet with community leaders and local authorities. It is important to ensure that the community agrees and understands the objectives of the project. This allows for full cooperation by the population. Researchers should explain how the results will be used e.g. discussing prospects for intervention.

Also, letters of notification should be presented confirming the timeline and dates of project involvement, explaining the purpose of study and asking for the population's cooperation.

It is advisable to obtain signatures from related authorities before the study begins acknowledgement of the notification. Confirming dates for the survey with the community will ensure that data is collected at an appropriate time that does not conflict with community activities.

Proper planning for the survey such as obtaining maps for sample selection, addressing geographic considerations, and getting consent from subjects and community leaders should also be included. This also involves gathering important information about population figures, security and access to the survey area. (Golden, 2006)

2.1.6 Checking availability of resources needed for surveying:

Infrastructure Needed:

1. Central office for staff meetings, maintaining records, and data entry
The office should be located in an area that is both central to the project sites as well as accessible to required labs. It should be in a secure location to ensure safety of databases in office computers, and should also have a regular supply of electricity.

2. Lab for testing food composition
Testing food samples collected in agro-botanical documentation for macro and micro-nutrients should be done as locally as possible to the data collection site to ensure accurate testing of samples while fresh.

3. Lab for testing serum micronutrient levels, if deemed necessary
In some communities serum testing may be considered necessary in order to accurately make a comparison between micronutrients that are dietarily available and the physical absorption levels of those micronutrients. The lab should perform at internationally recognized standards and should be located as close as possible to the project sites as blood samples must be analyzed as quickly as possible after they are taken.

4. Transportation and Accommodation arrangements
Most program areas are often large and public transportation is usually difficult. It is important to organize efficient and reliable transportation. As a general rule, one vehicle per survey team for the entire length of field interviews is recommended. Drivers who are familiar with the area are a valuable asset to the team. Vehicles should accommodate the appropriate number of people of the team and be able to navigate the poor quality roads in the project area. Logistics also include organizing accommodations for the survey teams. Central accommodation is usually preferred, as it enables the research team to minimize time wastage which results from uncoordinated efforts when research team members are accommodated in various places. Central accommodation also allows the team an opportunity to work on assignments together in the evening after the day's field exercise.

5. Access to Local Maps, Settlement Maps, and Local Guides
Maps are helpful during the survey for several reasons. Regional maps are often available from the Census Bureau or other government agencies. Local maps make it easier to find a small and remote village that might have been chosen as one of the clusters. Where possible, village maps use should indicate each household, but these are often difficult to find.

Settlement Maps:
If no village map is available, a team member should be dispatched in advance to sit with a local leader as well as walk around the village to draw the village map. It is important to include households and village landmarks such as rivers, churches or mosques, fields and large trees, as well as land used for agriculture and the crops grown on that land. This should essentially be an aerial view of the village, and will help show accessibility to resources for the village community. Copies of all of these maps should be made in advance for survey team members to take to the field Making a settlement map will make it easier to find places and might facilitate a good working relationship with the community being surveyed.

Use of local guides might be helpful in places where village maps are not available or reliable assistance cannot be provided to draw them. We must add that in many remote areas, local guides are very useful in helping the team navigate in the village easily and identifying selected households without hassle. The guide should be a well-respected person in the village/community to improve community's reception of the research team almost immediately (ORC Macro, 2005).

2.1.7 Sampling:

Sampling is the process in which information is obtained from selected groups within a population, with the aim of making general statements that apply to the population as a whole. There are several advantages in using sampling rather than conducting measurements on an entire population:

- Time and money savings: When sampling individuals, the reduced number of subjects that need to be contacted may allow more resources to be devoted to data collection and analysis.
- Information collected is more accurate: With a greater effort expended on the training of interviewers, more sophisticated measurements can be used, repeated measurements can be taken, and more detailed questions can be posed.

Some terminology:

- The term "target population" is commonly used to refer to the group of people or entities (the "universe") to which the findings of the sample are to be generalized.
- The "sampling unit" is the basic unit (e.g., person, household) around which a sampling procedure is planned.
- The "sampling frame" is any list of all the sampling units in the target population.

The general goal of all sampling methods is to obtain a sample that is representative of the target population. The procedures used to select a sample require some prior knowledge of the target population, which allows a determination of the size of the sample needed to achieve a reasonable estimate (with accepted precision and accuracy) of the characteristics of the population. Sampling methods include simple random sampling, systematic sampling, stratified sampling, and cluster sampling.

The most common sampling done in Bioversity projects is Cluster Sampling. For a detailed explanation of types of sampling and cluster sampling methodology refer to **Appendix 1**. For food consumption related studies, the sampling unit is the communal pot, or the number of people who eat from the same kitchen for their meals. Data should be collected according to this standard

in order to establish true relationships between nutritional status and food security potentials of farming systems.

2.1.8 Training the team:

Comprehensive training of the team is a vital stage in the survey process. The staff are taught survey procedures, how to collect data and appropriate use of the questionnaires. In addition, anthropometric techniques, such as measuring and recording should be practiced to ensure standardization of methods and collection of reliable data (Cogill, 2003).

Although some people are more adept at interviewing than others, one can become a good enumerator through training and experience. The training should consist of a combination of classroom training and practical experience. Before each training session, enumerators need to study the given manual carefully along with the questionnaire, writing down any questions they have, and asking questions at any time to avoid mistakes during actual interviews. Project Facilitators can learn a lot from each other by asking questions and talking about situations encountered in practice and actual interview situations. Training for the project facilitators should be scheduled just before the beginning of the survey.

It is important that all staff attend the training for the main survey. Due to the multi-faceted approach this nutrition manual promotes, it is essential for the nutritionist, agriculturalist, and anthropologist/ sociologist should all attend all training sessions to promote mutual understanding of the goals of the project, as well as to augment each training session with multi-faceted perspectives. The entire team should participate in all phases of the classroom training, including “role playing” interviews as well as the practice interviews in the field prior to the start of fieldwork. This will create unity among the team as well as utilize the expertise of the higher management in the process of understanding situations that might arise in the data collection process. A comprehensive overview if interview techniques can be found in **Appendix 2**.

Suggested Training Modules:

1. Identifying and Connecting with Communities
   a) Introducing the research purpose and targeted communities Generalizable populations, or similar groups that may benefit from the project
   b) Obtaining permission for research
   c) Developing a rapport

2. Developing Contextual Understanding
   a) Key Informant Interviewing
   b) Group Interviewing
   c) How to collect agrobotanical information
   d) How to log agrobotanical diversity
   e) Farm systems descriptions
   f) Collection of village demographics
   g) Creation of settlement maps
   h) Basic camera usage

3. Household Dynamics
   a) Observation of feeding practice and environment
   b) Observation of asset ownership
   c) Anthropometric Measurement 101
   d) How to take a food/activity log

4. Designing and Implementing Interventions
   a) Using data to understand agro-nutritional system gaps
   b) Community collaboration - identifying key impact areas
   c) Crafting solutions based on feasibility and sustainability

2.1.9 Design and Translation of the questionnaire:

A good questionnaire seeks to obtain the information required to meet all survey objectives with as few questions as possible. It should provide reliable data; in other words, the same answer will be provided by the same respondent regardless of who asks the question or where the question is asked. A questionnaire should outline exactly how questions should be asked. Questions and instructions for asking the questions must be clear. This way, each interviewer will ask the question in the same way. The most important quality of a good questionnaire is that every question has a purpose.

The layout of a questionnaire is important because it guides the interviewer through the survey process. The easier and clearer the layout, the less chance for error. Questions must be as clear and as simple as possible. Never ask for two pieces of information in one question. Always use simple words for which everyone has the same definition. One of the most important things to look for when the survey is field-tested is whether or not people understand the question easily or need to ask for further clarification. If respondents need to ask for clarification, then the question should be rewritten. It is important that the research team constructs the questions in the tool in consultation with the entire team to avoid use of terms that might bring about confusion during the survey process.

While the questions asked should be standardized to ensure understanding between project team members, some room should also be built in for open ended questions if they are deemed necessary in the process of the project. Also, natural flow in the interview style should not be avoided. This means that the project facilitator collecting data should allow the interview to move in the direction the interviewee takes it, allowing the questions to get answered in any order, and taking a final sweep back through in order to ensure that all questions have been answered. In this way, the interview becomes more of a conversation. The project facilitator should also remember to pay attention to and take note of any extra information the interviewee might provide as it may give a clue into something important left out in the questionnaire.

Translating the questionnaire into the local language ensures uniformity of questions asked. The questionnaire must be translated in a way that ensures both the interviewer and respondent interpret the meaning in the same way and, thus, have the same understanding about what information is sought. However, it is important to be sure that the translated questionnaire is really saying what the surveyor wants it to say. Often, the survey coordinator does not speak the local language, and in this case it is especially important to be sure that the translated questionnaire does not stray even slightly from the original intended meaning. Thus to check for translation accuracy, ‘double blind translation’ is used. With this technique, the survey coordinator gives the English version of the survey to a translator who translates the survey instrument into the local language. When the translator is done writing the questionnaire in the local language, it is usually a good idea to look it over with a local language speaker to make sure there are no mistakes.

The next step is to take the local language version to a different translator who translates the questionnaire back into English. Compare this translated English version to the original English questionnaire to see if both versions convey the same meaning. If the meaning of certain questions have changed, it is important to confirm that the initial translation is correct (ORC Macro, 2005; Dunford et al, 2004).

2.1.10 Pre-testing the Questionnaire:

Before starting the actual evaluation survey, the questionnaire should be pre-tested a small pilot study. Test the questionnaire early so that there is enough time to make needed changes. Pre-test the questionnaire in an area that is in the program area, but has not been chosen as part of the sample. The people or community interviewed in the pre-test should not be interviewed again for the actual survey (Dunford et al, 2004).

During the pre-test, it is likely that a number of problems will be identified. A pre-test allows the team time to fix these problems before the actual survey begins. It enables the team to further check the accuracy of the translation and investigate whether or not the respondents all have the same understanding of the questions.

Phase 2: Developing the Macro-Perspective

2.2.1 Building rapport with the community

Acquiring accurate information about a community's nutrition and agrobiodiversity situation is essential both for the purpose of research outputs and for designing interventions that address appropriately issues hindering improved food security and agroecosystems. Rapport is built through the cultivation of relationships of mutual respect and trust between community members and the program facilitators who will both collect data and implement any intervention deemed necessary. If the community does not have a good relationship with program facilitators, it will become almost impossible to work in the community. Because of this, the following points should be considered:

1. When hiring any staff that will have direct contact with communities, care should be taken to ensure that there are no ethnic tensions, social expectations, personality issues, or existing relationships that would potentially compromise the ability of the staff member to approach the community as a learner. This is particularly important in the selection of local guides or interpreters.

2. Data collection should not begin until consent from community leaders is granted. Additionally, the community must be publically notified that the research project is happening and given the opportunity to ask questions about the project.

3. Plan for ample exposure opportunities for the community to become comfortable with any staff that are new to the community.

4. Maintain professionalism at all times. The Project Facilitator Manager should regularly monitor activities of Project Facilitators to ensure that relationships with the community remain free of personal interest or gain.

2.2.2 Focus Group and Key Informant Interviewing

Efficiency in data collection should be prioritized by selecting parts of the data set that are generalizable to the entire community to gather through consolidated methods. By doing this the project facilitators save time as well as avoid redundancy in the data they collect. An overview of appropriate interview techniques for individual and group interviewing can be found in Appendix 2. Two types of specialized interviewing are recommended for collecting initial data about the community environment and cultural underpinnings:

Key Informant Interviews
Key informants are people in the community who are very knowledgeable about the area. They may be civic, religious, and political, opinion shapers or any other recognized leaders in the area. Key informant interviewing is used to gather data that would be considered common knowledge to the majority of people in the community, with an added level of expertise due to specialized experience or age. The most appropriate key informants for addressing issues related to traditional food system in a community will be:

- Community leaders familiar with the hunting, fishing and harvesting practices of the different family groups in the community
- Elders who consistently reside in the community and are familiar with the changes that have taken place during the last several decades
- The person in the household responsible for purchase, cooking, or portioning of food, or all of the above
- Primary caretakers, such as mothers, grandmothers or older siblings who play a key role in the care of the children under six years of age and living in households in the community who are familiar with the health of families
- The local health professionals, agricultural extension workers, or vendors, who are knowledgeable about the topics under review
- Traditional health practitioners

Focus Group Discussions (FGD)
A FDG is essentially a specialized interview of a group of experts. These group discussions are comprised of key informants who are identified and contacted from the community, and mobilized through their local leaders to discuss a specific topic or area in which they have expertise. Group members are encouraged to talk freely on the topic in question during such discussion sessions.

The purpose of a FGD will be to obtain in-depth information on the names of foods and food groups eaten, habitat, administrative division where food is found, market value, socio-cultural importance, traditional methods of food preparations, seasonal availability and gender preference of various foods.

Effort should be made to uncover foods to add to the traditional food list that may currently be little used or unused. This includes gathered foods that form a significant part of local communities' diets. Key informant interviews and focus group discussions with elders will be used to uncover this information. The extent of topics to cover and their depth is study and researcher- dependent and these are shaped by the research objectives.

FDG require facilitators who are excellent communicators, who speak the language of the community, and who are respected by the community. Both require a person recording proceedings. These proceedings will then be prepared into a report and discussed with the research leaders and community representatives for accuracy, or corroborated by an individual key informant interview.

2.2.3 Agroecosystems Analysis
FGD's and Key Informant Interviews will be used initially to collect data about the community's resources, markets, production, and power structures. The recommended data collection techniques are as follows:

1. Program Facilitators should create a settlement map by walking around and drawing an aerial view of the community, including transportation pathways, houses, land by crop, water sources, health centers, government offices, schools, market areas, etc. A complete view should be drawn including as well any nearby resources (such as a forest, ocean, or lake) that provide the community with any resources.

2. Soil samples for testing and GPS readings provide climactic information about the site.

3. A FDG is held in a public place where participants are asked to draw a picture of market flows of all goods produced in the community. This should include producers, middlemen, and major markets, as well as decision-making authorities controlling the flow of goods in and out of the community.

4. Another FDG should be held to collect data about the agricultural calendar, seasonality, all agricultural products, including market value and input costs

The above steps will help classify the farming system, used to categorize the area into a specific agronomic zone. Maps can be found in **Appendix 3**. This categorization will help the project facilitators to understand the setting of agronomic life in the area of work, including both potentials and deficits.

Additionally, using the Agro-ecosystems Perspective (Jones, 2005) the market and resource flow map made by the Focus Group can be understood.

2.1.4 Collecting Ethno-foods and Food Culture Data

Food Culture and Ethnofoods Data should be collected using the premade questionnaires in **Appendix 4**.

Ethnofood Data:
A survey should be conducted either with key informants or with a focus group to record and obtain samples of typical foods consumed in the area, as well as unique species available only in the area of study. This data will capture seasonality, harvesting and processing techniques of foods, and will obtain samples that can be assessed for nutritional value in the food composition lab.

Additionally, the project facilitator will take the group or individual through an interview about feeding and food culture norms. This is to establish cultural continuities regarding all aspects of feeding behavior in the homes of community members. This is an essential aspect of understanding food security because it expresses how food is actually allotted in the home, as well as people's beliefs about who and when specific foods should be consumed.

For each food listed the project facilitator should:

1. Take photos of the consumable, using a marked measuring stick and a solid colored background to capture the size and features of the food.

2. Take photos of the food at all stages of growth, harvest, and processing.

3. For unknown specimens, make drawings of the leaves, stems, fruit, and root system for ethno-botanical classification, or a drawing of the animal for the livestock specialist to classify.

What is "Folk Taxonomy" for food?
Gathering information about local categorization of items is an anthropological technique designed to uncover specific cultural norms about the items in question. Food is generally classified into different categories according to the values

or understanding of the culture in which they are consumed. The western model of food taxonomy is based on a combination of biology and taste. For example, though a bell pepper is technically a fruit, it is called a vegetable because it is generally used in savory preparations, and does not taste sweet. In other cultures different values may change the categories into which foods are allotted. It is important to capture this categorization in order to understand what foods may be easier or more difficult to recommend changing consumption patterns for. An example of this would be in China where the tangerine and the orange, two fruits that western taxonomy puts in the same family, are considered to be unrelated because they have different properties: tangerines are a heat inducing food, and oranges are cooling. Overeating one or the other will have opposite effects on the body: tangerines cause diarrhea and oranges cause constipation. Questions in the Ethnofoods questionnaire are designed to capture these perspectives, but it is also important to use patience and leave discussions open-ended in order to allow respondents the time to completely share their answers.

Food Culture Data:
Before nutritional data is collected at the household level, the project team needs to develop a sense of issues that could potentially contribute to household situations in which undernourishment is either more or less likely to occur. Socio-cultural attitudes about food and feeding practices contribute to actual accessibility to and utilization of foods on the household level, primarily because of food allocation. Focus group discussions should be used to collect this data, which can then be used as a springboard for further development of the household questionnaire.

2.1.5 Assessing Community Food Security

Food security is defined as the combination of access to food, availability of food, stability of food supply, and utilization of food either on the household or the individual level. Food availability shows whether or not adequate stocks of foods can be procured by households from their immediate environment. Accessibility assesses if the resources needed to actually obtain available foods exist at the household level. Stability shows patterns in availability over time, gauging the consistency of food supply on the household level. Finally, utilization considers both the bio-physical factors, such as micronutrient absorption rates, as well as the socio-cultural aspects of eating events and food allocation in the home. Each of these components is addressed in both the community and household interviewing process.

Type of Data	Food Security Indicator Information
Agroecosystems visualizations	Availability, Accessibility
Food culture data	Utilization, Availability
Farming system classification	Availability, Accessibility
Seasonal Farming Calendar	Availability, Stability
Household income	Accessibility, Stability
HDDS, MAHFP	Availability, Stability
Sanitation, health, and home facilities	Utilization
Nutritional Status	Utilization, Stability

2.1.6 Food Composition Scoring

Samples from ethno-foods collected should be assessed for nutritional composition information at a local lab. Total nutritional values should be broken down according to macronutrients

(fat, dietary fibre, carbohydrates, protein), and micro nutrients (essential vitamins and minerals). Attributed compositional values will enable researchers to develop the nutritional functional diversity indicator which will be used to express the capacity of the local environment to provide a nutritionally balanced diet. The functional diversity indicator, developed by the Earth Institute at Columbia University, quantifies the depth and breadth of agro-biodiversity according to dietary usage (Remans, Flynn, 2011). Bioversity's nutrition research projects will work collaboratively with the Earth Institute to provide data as well as test newly developed technology for data entry and analysis of nutritional functional diversity. Charts for recording compositional data can be found in **Appendix 6.** Food composition scores should also be used to express dietary uniqueness according to nutrients at the cultivar level. Comparative data for communities that consume more than one type or a unique type of a food should be assessed and submitted to the FAO Infoods Database for cataloguing.

Phase 3: Assessing Food Security and Nutritional Status at the Household Level

2.3.1 Gathering Socio-Demographic Data

The overall objective of the socio-demographic questionnaire is to understand food use, as much as is possible, on a year-round basis (Frison et al, 2006), and to catalogue and make connections between the following factors: nutritional status, age, birth interval, education levels, literacy rates, income, profession, health and sanitation, and disease history. A complete sample household survey, including both socio-demographics and anthropometric analysis can be found in **Appendix 7**.

Nutritional status is affected by food use and consumption, health, environmental factors and care practices. In order to maintain food security, a household must have adequate food supplies to meet the dietary requirements of all members. Nutrients can be obtained through either the production or the purchase of food. The ability to produce and obtain food is determined by several factors included in the household survey questionnaire:

- Household income: Poverty is associated with underweight and micronutrient malnutrition because the diets of poor households and communities are quite often either in quantity or quality. Either enough calories are not being consumed in the first place, or the calories that are consumed are largely from one macronutrient category, not providing the full suite of vitamins and minerals needed to help the body function properly.

- Education and Literacy: Education levels of family members and particularly those who earn for the family are related to poverty levels, as higher educated individuals frequently have more job accessibility. Additionally, literacy is related to poverty and nutrition levels it two ways: first in that illiterate individuals have less access to information that could improve their nutritional habits and health, and second in that the less educational experience an individual has had the less exposure they have had to health related teaching in the school setting.

- Health and Sanitation environment: Health and nutrition are closely linked in a cycle, in which diseases contribute to malnutrition and malnutrition makes individuals more susceptible to disease. These factors depend on access to health services, safe water, adequate sanitation

and housing which are in turn affected by access to services and infrastructure and affordability to the population.

- Disease History: Because recent bouts of sickness can have an effect on the weight, and therefore the wasting and BMI calculation, it is important to note any incidence of sickness within the week before weighing for each participant weighed.

2.3.2 Anthropometry and Nutritional Status

Anthropometric Measurements:

Anthropometry measures changes in body dimensions. It is used to assess growth and nutritional status of individuals or populations. The main building blocks of anthropometry are age, sex, weight, height and oedema. Combined, these building blocks - commonly referred to as indices - provide valuable information on an individual's nutritional status. In order to correlate agroecosystems and dietary diversity data with nutritional status, accurate and complete anthropometric measurement of targeted populations in a community are essential. Please see **Appendix 8** for detailed instructions on how to perform anthropometric measurements.

Common software used for analysis of nutrition and public health data, is EpiInfo, with the accompanying EpiNut. This program enables range and logic checking, enhancing the accuracy of results. Once the data has been entered and its quality is approved, the next stage is analysis.

Analysis of anthropometric data:

Child nutrition and health data is examined by determining the percentage of children affected by the main types of malnutrition: wasting (low weight-for-height), stunting (low height-for-age), and underweight (low weight-for-age). The individual indices are compared to an international reference standard. These reference standards should not be considered 'ideal' as they are only used to compare nutritional status in different regions and in population over time. The Reference Standard most commonly used is that of the WHO. Nutrition indices can be expressed in two ways, derived from different methods: as a percentage of the median value of the reference standard, or as Z-scores obtained from the reference standard.

An individual can be classified as normal, or suffering from moderate or severe malnutrition. In general, a Z-score above -2 (or 80% of the median) is normal, less than -2 (below 80% of the median) or above -3 z-scores (70% of the median) indicates moderate malnutrition, and a Z-score of -3 (70% of the median) indicates severe malnutrition for all indices (SMART Methodology, 2006).

MUAC

MUAC is an appropriate tool to measure a child's acute nutritional status. It is carried out using a calibrated coloured styrene strip/tape and the measurements are interpreted as follows (WHO, 2006):

<11.0 cm (Red)	= Severe acute malnutrition
11.0 cm – 12.5 cm (Orange or Red in 3-colored strip)	= Moderate acute malnutrition
12.5 cm – 13.5 cm (Yellow)	= Risk of acute malnutrition
>13.5 cm (Green)	= Well-nourished child.

Oedema

Oedema can be graded as absent, mild (+), moderate (+ +) or severe (+ + +) (SMART, 2006):

+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

BMI

Body Mass Index is used for older children and adults for assessing weight categories that constitute risk factors for certain diseases. Individuals are classified as follows (WHO, 1995):

BMI < 18.5	=underweight
>18.5 to <24.9	= normal
>25.0	= overweight
>30.0	= obese

The BMI calculation is limited in use in famine situations as adult nutritional oedema is common, meaning that increased body weight produces a false ration of body weight over height. BMI will thus not be appropriate nutritional assessment tool for individuals suffering from famine oedema, unless combined with an assessment of the prevalence of famine oedema (Collins, 2000).

Field assessment of undernutrition:

All individuals weighed and measured should have their stunting, wasting, underweight and/or BMI calculated on the spot to give immediate medical advice to those needing treatment. Examples of field tables and charts used for quantifying calculations can be found in **Appendix 9**. It is also recommended to give "Road to Health" charts, or charts for long-term recording of weight and height for all children under 5 measured. During the data collection process project facilitators may come across individuals who are severely malnourished. In these cases it is extremely important for the team to have a pre-planned procedure for advising the family and individual and referring for medical treatment.

2.3.3 The 24 hour food recall

A 24-hour recall collects information on food intake over the previous 24-hour period. The household member responsible for food preparation is the preferred survey respondent. Other members of the household rarely know what foods were consumed by individual household members nor are they likely to be able to identify or recall the ingredients used in meal preparation. This process is included in the Household Questionnaire in **Appendix 7**.

For ease and accuracy of data collection and analysis, the reference period for 24-hour recalls should be the day before the interview. This provides the respondent with a clearly defined beginning and end of the reference period. The interviewer should ask about all foods consumed in the household the previous day, beginning when the first person in the household woke up, and using that as a reference point to start the day's recall. The respondent is then asked about all foods prepared and/or consumed until the last person in the household went to bed.

When using the 24-hour recall method, the interviewer should first ascertain whether the previous day was "usual" or "normal" for the household. If it was a special occasion, such as a funeral or feast, or if most household members were absent, the interview should be moved to another day. If this is not possible, it is better to select another household rather than subject the respondent to recall information from longer than 24 hours. The respondent should include the food groups consumed by household members in the home, or prepared in the home for consumption

by household members outside the home (e.g., at lunchtime in the fields).

A one-time 24-hour recall tool is useful to obtain group averages of food intake and nutrient intake, but cannot be used to establish average intake for the individual because of the diversity of intakes from day to day. Information collected during a 24-hour recall may vary in the depth of information collected based on the objective of the study. (Kuhnlein et al, 2006).

In most dietary diversity projects, information on the amounts of foods consumed may not be as important as the diversity consumed and yet collection of both may lead to lengthy questionnaires that would result in fatigue and inaccuracies. In such cases, the columns for amounts consumed and the indicative local measure used may be omitted.

Prior to 24-hour recall interviews, it is strongly recommended that research team make visits to research communities aimed at understanding cooking methods, recipes and usual amounts of ingredients applied as well as local household measures. It is helpful for this to take place in the context of collecting ethno-foods data. This is done by holding community-run and based cooking sessions with representative individuals (usually women). In such meetings, the research team will measure the amounts of ingredients used by various group members and an average is agreed upon and at the same time, local measures used are measured and recorded.

To help the responder remember the foods ate yesterday, it is recommended to use the multiple-pass method (Conway, 2003, 2004). This method consists of 5 steps:

1) The quick list, which is an uninterrupted listing by the subject of foods and beverages consumed;

2) The forgotten foods list, which queries the subject on categories of foods that have been documented as frequently forgotten;

3) A time and occasion at which foods were consumed;

4) The detail cycle, which elicits descriptions of foods and amounts eaten aided by the interactive use of the Food Model Booklet and measuring guides; and

5) The final probe review.

In cases of several recalls, these should be non-consecutive and the period between recalls should not be long (Buzzard 1998, Willet, 1998). An interval of 7 to 14 days is acceptable, but 7 or 8 days is highly recommended (Jackson, 2008).

The 24 hour food recall gives the project facilitators the opportunity to develop a case by case understanding of actual food consumption levels. Additionally consumption of species or cultivars found to be nutritionally unique during the food composition analysis portion of the study should be recorded in order to assess how beneficial these unique sets of nutrients actually are related to nutritional status. Consumption counts of specific foods can also be submitted for cataloging to the FAO Infoods Database.

2.3.4 HDDS and MAHFP Measurement

The Household Dietary Diversity Score (HDDS) and Months of Adequate Household Food Provisioning (MAHFP) are both used in tandem with the 24

hour food recall to express food security at the household level.

HDDS is assessed using the information from the 24 hour food recall together with the multiple pass method (described in section 2.3.3) to record whether or not foods from specific categories have been consumed in the past week.

The data collected about agricultural seasonality in Phase 2 of the project will contribute a list of expected foods consumed at certain times of the year. MAHFP is designed to encapsulate the aspect of seasonality by showing times of abundance and scarcity throughout the year. If large discrepancies are reported, a modified HDDS can also be completed for the converse season to the one in which data is being collected in order to assess nutritional intakes throughout the entire year.

Phase 4: Data Analysis and Baseline Study Report Writing

2.4.1 Expected outputs by indicator

The baseline study report should include data systematized into the following outputs:

1. The Agroecology of the Region of Study: Includes classified farm system, and summary of agroecological systems.

2. Biodiversity of Foods Produced in the Region of Study: Expressed in the Nutritional Functional Diversity Index, which will be assessed in collaboration with the Earth Institute at Columbia University as user friendly data processing methods are being developed.

3. Overview of Food Security in the Region of Study: Food accessibility and availability, and the supply and utilization of the food supply as related to household poverty levels, cultural attitudes about food and feeding behaviors, physical ability to utilize foods, seasonality, and market effects on food supply.

4. Nutrition Status Comparisons: Anthropometric measurements of households enable comparison of rates of stunting, wasting, and underweight in the community of study, and their relationship with the poverty level of individual households.

2.4.2 Report Writing

It is crucial to document all stages and the key findings of research in a systematic and credible way. This is done in the form of a report. This should be brief, but must include all available relevant information.

The following format is suggested for a report (Webb and Bhatia, 2005):

1. Summary or Abstract: This section is often completed last. It must be succinct, summarizing all the important information in the report, such as the geographic area covered, the date, objectives, methodology and main results. This can be presented either in table or paragraph form.

2. Introduction: This section describes the current situation of the area in which the project is to be done. It should include basic population socio-demographics, agroecological setting, and local and regional traits or trends.

3. Objectives: This is an ordered list of what the project hopes to discover and accomplish during the allotted project duration.

Indicators and Expected Outputs		
Indicator/s Used	**Expected Output**	**Use of Output**
Soil sampling, elevation, GPS coordinates, cropping systems, water resource availability	Classified Farming System	Crop and livestock change recommendations can be tailored to the agroecological environment; also used as an agroecology indicator.
Farming system, settlement map indicating resources, community visualization of production, consumption, and market flows, decision making processes	Summary of community agroecology	Targeting of production potentials through understanding how the community visualizes who are decision makers, how access to resources is determined, and where bottlenecks are in market flow.
Staple/non-staple food security rates, food composition data, richness within species/ food categories, evenness between species/food categories	Nutritional Functional Diversity Index	Expression of the depth and breadth of nutrients available in consumables produced both at the household and local levels.
Amount of production by product overall, amount of production retained for food usage	Production Adequacy Percentage (PAP)	Shows amount of produce actually consumed by the producer in relation to total food production. Expresses competency of households to produce their own food.
Cost of food, proximity of markets, rates of self-production	Description of Food Accessibility	Used to describe overall food security at the household and local level, and marks according to indicator which factors could be creating either gaps or successes in food security for households.
Illness, MAHFP, PAP, 24 hour food recall	Description of Food Availability	
Agricultural calendar/ seasonality, market price fluctuation	Description of Stability of food supply	
Food culture and eating patterns, food taboos, folk taxonomy of food	Description of Utilization of food resources	
Weight and age	Percentages of Underweight	Indicates overall inadequate growth related to chronological age. This initial indication should be further interpreted by wasting and stunting calculations.
Weight and height	Percentages of Wasting	Indicator of the presence of short-term (acute) undernutrition in a population.
Height and age	Percentages of Stunting	Indicator of the presence of long-term (chronic) undernutrition in a population.
Income, housing type, health and hygiene, education, literacy	Poverty Level	Shows relative availability of resources as well as seriousness of need for development opportunities.

4. Methodology: This describes the methods employed and enables readers to assess the validity of the survey and have a clear reference for future comparison. This section includes sampling techniques, measurements taken and by whom, and the instruments used. In addition, training of the research team is detailed, and survey design and administration is described. This section should also comprise the indicators used and cut-off values.

5. Results: The results should be presented in a standardized format to facilitate comparisons with other sources. It mainly consists of graphs and tables illustrating the analyzed results, and explanations of those tables.

6. Limitations: Examples of limitations that could be encountered are those during team selection and training survey design, sampling and analysis. For instance, problems such as unexpected population movement, or factors affecting access to the sample population such as security constraints.

7. Discussion: The aim of this section is to explain the results. Information is obtained from the results section, and considers major findings in light of other information gathered from prior surveys, other assessments, observations, discussion with community leaders and project facilitators.

8. Conclusion

2.4.3 Filling Informational Gaps

During the report writing phase, it is common to discover specific pieces of information missing that lend needed perspective to the project. These can happen if questionnaires are not fully completed, or if an unanticipated set questions need to be answered. This can be largely avoided if a pilot study is completed at the beginning of the study and compared to study objectives or if data is continuously entered and analyzed as it is collected. Nevertheless, sometimes gaps occur later in the study and they should not be neglected as they may cause the study to miss inclusion of a factor important to creating a clear picture of the agroecological or nutritional situation of the community of study.

Phase 5: Intervention Design

2.5.1 Basic principles in designing a successful intervention:

The data collected during the research stage of the project begins to bear fruit in the intervention design stage. In order to improve nutritional outcomes of targeted groups of people, it is important to design an intervention that is acceptable culturally, economically, and ecologically. An overview of examples of issues brought up through research and possible approaches to answering these can be found in Appendix 10. The following principles should be considered in the process of designing an effective intervention (Le Cuziat & Mattinen, 2011):

1. First, Do No Harm. For each recommended intervention step devised, a clear list of both benefits and risks for the step should be developed. Consideration of the risk aspect of behavior change can make or break the acceptability of an intervention recommendation.

2. Involve community leaders and progressive community members in the design process by presenting them with the results of the baseline study and collecting their feedback and suggestions.

3. Utilize local capacity in new ways. Avoid designing a program that remains depend on outside funding for the long-term and that over taxes existing social servants. Instead, aim to find new avenues for improving local expertise as well as community access to that expertise.

4. Make a clear plan. Thoroughly outlined objectives and expected outcomes make the monitoring and evaluation process smoother.

5. Recommend a system that will meet nutritional needs year round. Seasonality and improved storage techniques and capacity can add longevity, improving food security.

6. Design the intervention in stages, starting first with the smallest change possible for the largest impact possible. Initial successes with project recommendations will instill confidence in the community and make them more likely to try higher risk changes.

7. Make recommendations concise and actionable to improve usability and understandability for the community.

8. Pay attention to local norms: Sensitivity to family decision making processes, liquidity of income, festival and special occasion obligations and their costs, and other nuances of household resources is essential.

9. Design appropriate communication strategies. Evaluate what will make the information functionally available to the greatest number of people.

10. Be inclusive. Even when targeting the intervention at a specific group within a community, care should be taken to not alienate the non-target groups, potentially causing complications for either the researchers or the recipients of intervention attention. Think of creative ways to involve non-target groups in the roll-out of the intervention.

2.5.2 Identifying Successes and Gaps

The positive deviance approach advocates for viewing the community not as a set of problems to be solved but a set of potentials to be realized. Often both the capacity and the resources for positive sustainable change already exist within the community. Data collected should be used to identify “positive deviants”, households in the community that are comparatively nutritionally successful in spite of income and resource limitations, and discern what behaviors could be making them more successful than other households in the same situation. These behaviors should be used as a backbone for intervention development. The PD approach promotes behavior change that comes from within the community, allowing it to be language and medium appropriate because it is culturally relevant, based on preexisting strengths and assets within the community, not expert driven, and “generative”, or having the ability to build upon itself (PD Basics, 2009).

2.5.3 Types of Interventions:

When designing an intervention that aims to address community issues both holistically and sustainably, a combination of approaches is generally warranted to create a customized package of recommendations to meet needs uncovered in the process of the baseline study. Approaches include, but are not limited to, the following list: (Le Cuziat & Mattinen, 2011)

1. Agroecological Interventions: These interventions address issues of resource accessibility, market flows, agronomic practice, and production decision making on both the household and local level. Quality and quantity of products, as well as the capacity of the local agroecosystem to meet nutritional needs can be improved through adjustments in soil fertility, increased sharing of resources, creating new market opportunities, promoting intensification and diversification in cropping, and many other aspects of agroecological systems.

2. Awareness-based Interventions: Community based education is the basis of these interventions where resources available are adequate, but access is restricted functionally due to socio-cultural behavior patterns or public health complications. Ensuring that families are not nutritionally compromised because of unclean food handling, lack of understanding of the caloric needs of specific individuals within the family, or other complications of understanding.

3. Cash-Based or Food Aid Interventions: Though less desirable because long-term sustainability depends on outside sourcing, these interventions can be considered in cases of immediate and severe compromise of food security. Either providing food sourcing of staples from outside the community, or incentivizing nutritional change through cash payments to increase purchasing power should only be done if absolutely necessary and coupled with other intervention strategies that develop local production capacity and accessibility for the future.

4. Economic, Market-Based Income Generating Interventions: Aimed at increasing availability and liquidity of financial resources, these interventions should be designed keeping in mind the need to ensure that increases in income will be coupled with increased spending on nutritionally rich foods.

2.5.4 Community Involvement in Intervention Design

Project staff should be facilitating positive change, not creating the change themselves. In order for change to take root in a sustainable way, the community must develop a sense of responsibility towards the change. Recommendations must be inclusive of entire family units in the case of nutritional agro-biodiversity interventions. The best approach for this is an intervention based focus-group discussion where project facilitators point out specific successes and gaps in the nutrition and agro-biodiversity picture, and ask the members of the group to make suggestions of how these problems could be remedied, or how successes could be replicated.

2.5.6 Phasing Interventions for Manageability and Sustainability

Too many changes implemented too quickly can ruin the chances of a potentially successful intervention getting its desired results. The intervention should be designed in stages or phases in order to prove efficacy to the target community.

1. Target early-adopters within the targeted community. Because of the risk involved in adopting some intervention recommendations, the average household will not be willing to buy in until they see successes in the community. This is akin to the concept of conducting field demonstrations for farmers to see improved yields and vitality of new varieties. Within each community there will exist a few households

who are willing to try something new, and these families can demonstrate the benefits of behavior change to the rest of the community. Additionally, positively deviant households who already have higher levels of success compared to others of the same socio-economic situation are natural examples to present to the community.

2. Order recommendations with a mind to both short and long-term benefits in order to ensure that some success is experienced immediately to instill community confidence in the intervention.

3. Front-load the intervention with lower risk recommendations to create a platform from which trust in the project facilitators can be slowly built.

Phase 6: Intervention Roll-out and Assessment

2.6.1 Expected timelines

The project should be scaled in the initial stages according to capacity that is manageable for 2-3 project facilitators per targeted site. Accordingly the intervention will be pre-adjusted to handle necessary time commitments on the part of the project facilitators. Intervention roll-out is expected to take at least the same amount of time, and more realistically, more time than the data collection and analysis stage took. It is essential to continue to build upon the relationships already established in the community, with the actual intervention being the pinnacle of the research done. Care should be taken by the program staff to ensure that intervention implementation is not rushed in order to give the community ample time to observe successes as they happen and try recommendations themselves. In a sense, the intervention is the major substantative portion of the entire project where change is supposed to actually occur in the community.

2.6.2 Monitoring and Reporting

In spite of excellent planning, an intervention can fail in the implementation stage due to unforeseen factors preventing acceptance of recommendations or hindering expected results. Because of this, regular evaluation of intervention process should be undertaken both by the Project Facilitators assigned to a specific community, as well as by the PF Manager. An evaluation should return to the objectives and expected outcomes of the intervention to assess the following:

1. Is the community accepting the intervention recommendations?

2. If not, why are they not accepting the recommendations?

3. If yes, are the recommendations having the desired effect?

4. If no, why not?

5. What could be changed about the approach to make the intervention more successful?

Answering these questions systematically at regular intervals will ensure that time is not wasted emphasizing a faulty recommendation. Evaluation enables mistakes to be corrected rapidly before creating a long-term perception by the community that the project is ineffective.

Phase 7: Final Evaluation of Intervention Efficacy

2.7.1 When does a project end?

While the process of development is always ongoing in any community, it is important for the program staff to develop a sense of when the community has developed enough independence to continue in the development process without outside inputs. The following questions can be used as a guideline for gauging when project staff are no longer needed:

1. Have the majority of the community adopted and experienced success with at least one of the intervention recommendations?

2. Has the nutritional status of the community as a whole improved and remained in its improved state during the course of the intervention?

3. Have community members developed the ability to teach each other how to implement intervention recommendations?

4. Have community members come forward to take over leadership responsibilities in intervention implementation?

2.7.2 How to gauge continued involvement

Throughout the intervention design and implementation process, staff members should be assessing timelines and human capacity potentials for desired growth. There may be situations when continued outside input in the form of expertise, financial resources, or manpower may be deemed necessary in order for the community to continue on more autonomously in the development process. It is essential to ensure that this involvement is actually necessary, and that not providing the resource could compromise the overall effectiveness of the project. Additionally, this should be viewed as an opportunity for designing or improving macro-systems to provide the necessary resources in a more organic way.

Section 3: **Tools and Techniques Appendix**

Appendix 1: Sampling Techniques

Sample Types and Cluster Sampling Methodology

Simple random sampling is used when 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 used when there is a small population. The simplest way of selecting sampling units where each unit has an equal probability of being chosen is referred to as a simple random sample.

Systematic sampling 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. The ordering may be based on the date a patient entered a clinic, the last surname of patients, or other factors. This method of sampling is easy to implement in practice, and the sampling frame can be compiled as the study progresses.

Stratified random sampling is used by dividing up the population into distinct non-overlapping subgroups (strata) according to some important characteristics (e.g., age, income) and then a random sample is selected within each subgroup. The investigator can use this method to ensure that each subgroup of interest is represented in the sample. This method generally produces more precise estimates of the characteristics of the target population, unless very small numbers of units are selected within individual strata.

Cluster sampling (also called multistage sampling) is used in large populations where no accurate population register is available and households cannot be visited systematically. However, the sample size is always greater so that more households need to be visited. The clusters or regions are selected, preferably at random, and the persons are enumerated in each selected region and random samples are drawn from these units of the population. Because sampling is performed at multiple levels, this method is sometimes referred to as multistage sampling. It is done in two stages:

1. The villages with the clusters, or sampling sites, within the total population are selected randomly according to their size, and

2. The required number of houses within each cluster are selected and visited.

Cluster Sampling

Stage one: Selecting the cluster

Cluster sampling requires the grouping of the population into smaller geographical units like villages (see figure 1). 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 in a village, two adjacent villages should be combined at the planning stage. It is critical to also cluster based on agroecological zones or factors.

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.

Steps in choosing the clusters:

1. Determine the sample size. This refers to the number of children to be included in the survey. The calculation of sample size always depends on three main factors:

    a. The estimated prevalence of the variable of interest (chronic malnutrition in this case),

    b. The desired level of confidence, which is the minimum precision around the estimate that will give a useful result, and

    c. The acceptable margin of error.

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. 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. Document the names of all the villages (districts or sections on map) and their population size. The order you enter the villages is not important, but it is important that they all be included. From there, using a random sampling tool, select the villages that should contain a cluster. 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.

Step 1: Base sample size calculation
This can be calculated using the formula:

$n= [t^2 \times p(1-p)]/m^2$ where,
n = required sample size
t = confidence level at 95% (standard value of 1.96)
p = estimated prevalence of malnutrition in the project area
m = margin of error at 5% (standard value of 0.05)

Step 2: Design effect
This is a correction factor accounting for heterogeneity among clusters in the population. Cluster sampling requires a larger sampling size than other forms of sampling because subjects within the same cluster are generally more similar to each other than members of different clusters, therefore decreasing precision. This imprecision can be compensated by increasing the sample size calculated for a simple random sample by the design effect:

N = n x D where,
n= sample size, D= design effect
The design effect is generally assumed to be 2 for nutrition surveys using cluster-sampling methodology.

Step 3: Contingency
Here the sample is further increased by 5% to account for contingencies such as non-response or recording error.

Step 4: Distribution of observations
In this final stage, the calculation result is rounded up to the closest number that matches well with the number of clusters (30 villages) to be surveyed.

Thirty is the standard number of clusters established by the WHO Expanded Programme of Immunization (EPI Cluster Surveys). However, it is not necessary to maintain exactly 30 clusters, and the number can be adjusted if there is a compelling motive for doing so (IFAD, 2010).

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 are more efficient than 30 clusters of 30 children. 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.

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.

Steps in using the segmentation method to choose sample households:

1. Calculate the number of segments to be created. Divide the number of households recorded in the last census by the target segment size. The result will be the number of segments to be created in the field. For example, if the last census indicated that there were 250 households in the cluster and the target segment size was 40 households, 6 segments would need to be created. (Note that in performing this calculation, decimal numbers of segments should be rounded to the nearest whole number).

2. Update the cluster map. Using a map of the cluster, verify/update the external boundaries of the cluster and enter any internal features that may be useful for dividing the cluster into easily recognizable segments.

3. Count and indicate the location of households located in the cluster on the map. This is intended to be a quick operation undertaken so that the cluster can be divided into segments with approximately equal numbers of households.

4. Based on the cluster map, divide the cluster into equal-sized segments. The number of segments to be used is the number determined in Step 1 above.

5. Choose one segment at random.

6. Interview all households located within the boundaries of the randomly chosen segment.

Appendix 2: Interview Skills

The following dos and don'ts during interviews are recommended (Kuhnlein, 2006):

1. Make a good first impression.
When you arrive at the household, do your best to make the respondent feel at ease. With a few well-chosen words, you can put the respondent in the right frame of mind for the interview. Open the interview with a smile and greeting and then proceed with your introduction. In many communities, the first impression is made before one says any word depending on how one is dressed. Appropriate dressing is the first non-verbal step.

2. Obtain respondent(s) consent to be interviewed.
One must obtain a respondent's informed consent for participation in the survey before you begin an interview. Special statements are normally included at the beginning of the Questionnaire. The statements explain the purpose of the survey. They assure a respondent that participation in the survey is completely voluntary and that it is their right to refuse to answer any questions or stop the interview at any point. Use the words as your guide and conduct this in a conversational manner allowing questions where and when they arise. Answer any questions from the respondent frankly and accurately as possible. Avoid telling lies for the sake of having the respondent's consent as these lies could end up, as they will in most cases, becoming impediments to future activities due to lack of trust. It helps, while attempting to obtain the 'respondent's' consent, when you explain that the results of the survey are indeed confidential, as some would fear their situation being exposed to the public, especially with poor households.

3. Interview the respondent alone.
The presence of a third person during an interview can prevent you from getting frank, honest answers from a respondent. It is, therefore, very important that the individual interview be conducted privately and that all questions be answered by the respondent.

If other people are present, explain to the respondent that some of the questions are private and ask to interview the person in the best place for talking alone. Sometimes asking for privacy will make others more curious, so they will want to listen; you will have to be creative. Establishing privacy from the beginning will allow the respondent to be more attentive to your questions.

In some situations however, for some questions, regarding household budgets, men can be more helpful than women, while for questions regarding household food preparation, consumption, feeding practices and care, women normally come in handy. In such questionnaire, both man and wife or primary care giver should be allowed to respond together or consult with each other.

4. Keep neutral throughout the interview.
Most people are polite and will tend to give answers that they think you want to hear. It is therefore very important that you remain absolutely neutral as you ask the questions. Never, either by the expression on your face or by the tone of your voice, allow the respondent to think that she has given the wrong answer to the question. Do not appear to approve or disapprove of any of the respondent's replies.

5. Never suggest answers to the respondent.
If a respondent's answer is not relevant to a question, do not prompt her by saying something like "I suppose you mean that. . . Is that right?" In many cases, she will agree with your interpretation of her answer, even when that is not what she meant. Rather, you should probe in such a manner

that the respondent herself comes up with the relevant answer. You should never read out the list of coded answers to the respondent unless you are instructed to do so in that question. If the respondent gives an ambiguous answer, try to probe in a neutral way.

6. Handle hesitant respondents tactfully.
There will be situations where the respondents simply say, "I don't know," give an irrelevant answer, act very bored or detached, or contradict something they have already said. In these cases, you must try to re interest them in the conversation. For example, if you sense that they are shy or afraid, try to remove their shyness or fear before asking the next question. Spend a few moments talking about things unrelated to the interview (for example, their town or village, the weather, their daily activities, etc.).

If the woman or man is giving irrelevant or elaborate answers, do not stop him/her abruptly or rudely, but listen to what he/she has to say. Then try to steer him/her gently back to the original question. A good atmosphere must be maintained throughout the interview. The best atmosphere for an interview is one in which the respondent sees the interviewer as a friendly, sympathetic, and responsive person who does not intimidate him and to whom he can say anything without feeling shy or embarrassed. As indicated earlier, a major problem in gaining the respondent's confidence may be one of privacy. This problem can be prevented if you are able to obtain a private area in which to conduct the interview.

7. Do not hurry the interview.
Ask the questions slowly to ensure the respondent understands what is being asked. After you have asked a question, pause and give the respondent time to think. If the respondent feels hurried or is not allowed to formulate their own opinion, they may respond with "I don't know" or give an inaccurate answer. If you feel the respondent is answering without thinking just to speed up the interview, say to the respondent, "There is no hurry. Your opinion is very important, so consider your answers carefully.

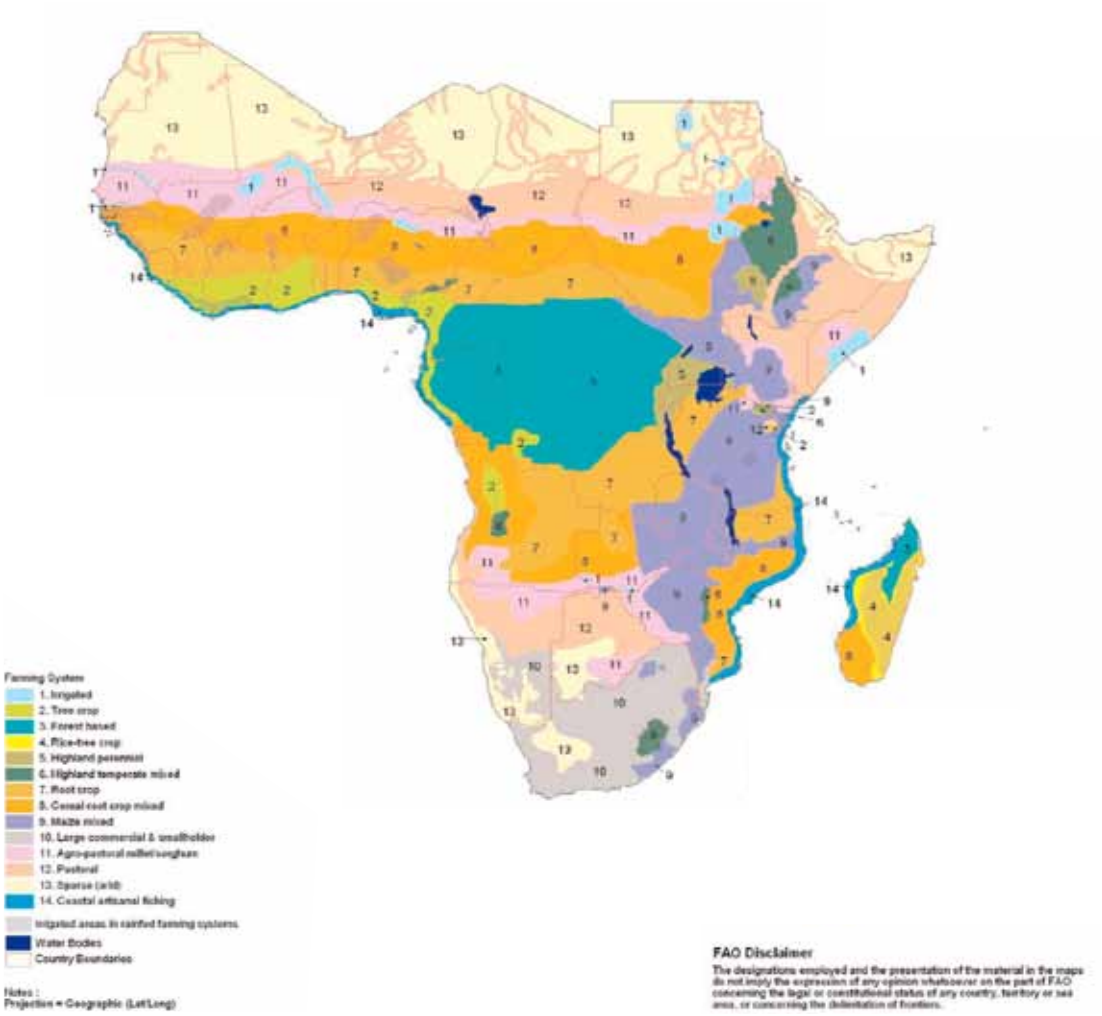
Appendix 3: Agroecology and Farming System Assessment Maps

The farming system of the study area can be extrapolated from the Farming Systems and Poverty (WB/FAO) data maps found below. Detailed views of specific regions within countries according to farming system is available at http://www.generationcp.org/gcpatlas/

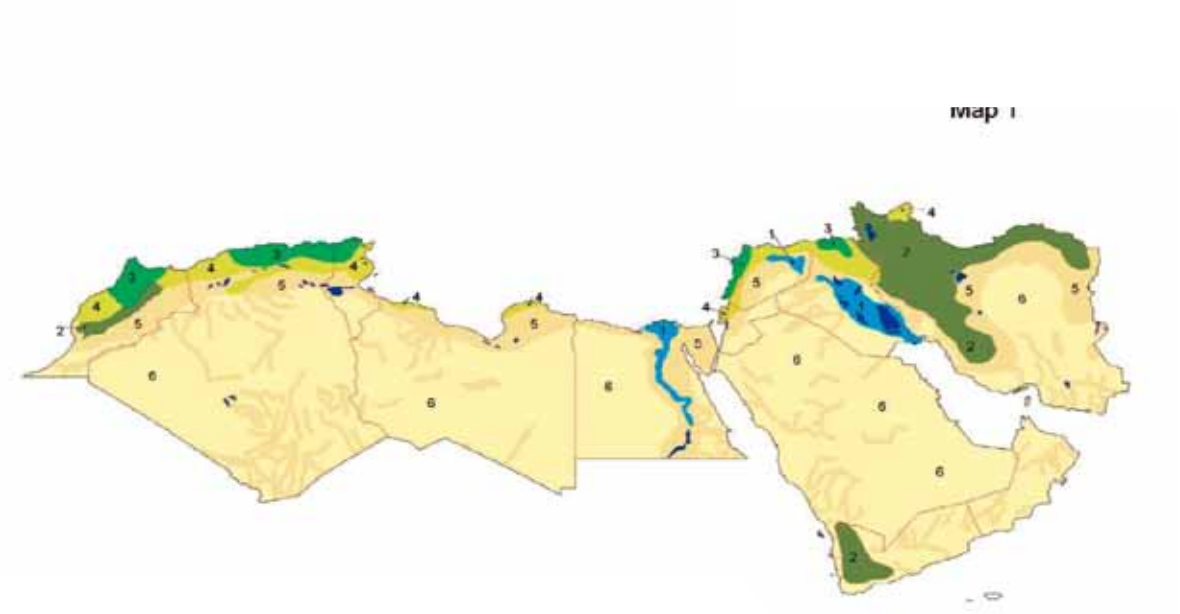
Additionally, data from the Community Level Agrobiodiversity Indicators Questionnaire (Appendix 4), gives local cropping information, production levels, and agricultural calendar seasons according to product, and market costs and fluctuations. Edible local products are catalogued in the ethno-foods data sheet, contributing more detailed information about unique foods and their nutritional status. This information will help the team ascertain if there are variety related nutritional differences in the ethno-foods available to the community of study.

Major Farming Systems **Latin America and the Caribbean** Map 1

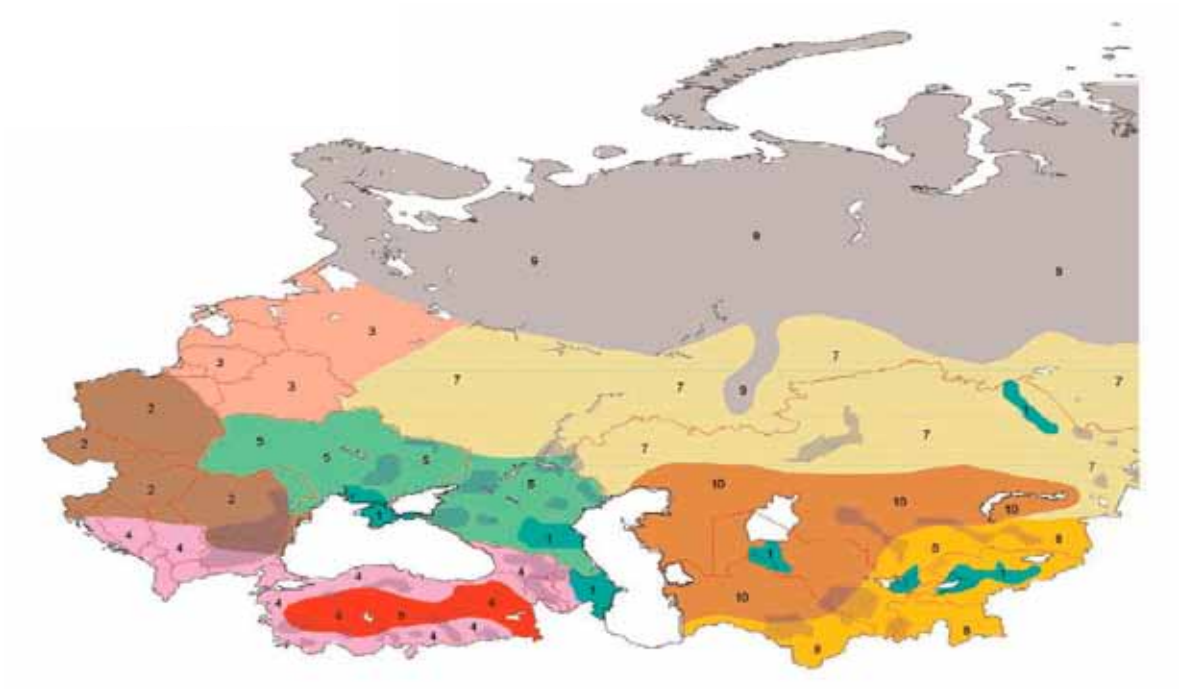
Major Farming Systems **Sub-Saharian Africa** Map 1



Major Farming Systems **Middle East and North Africa** Map 1



Major Farming Systems East Europe and Central Asia — Map 1a



Major Farming Systems East Europe and Central Asia — Map 1b

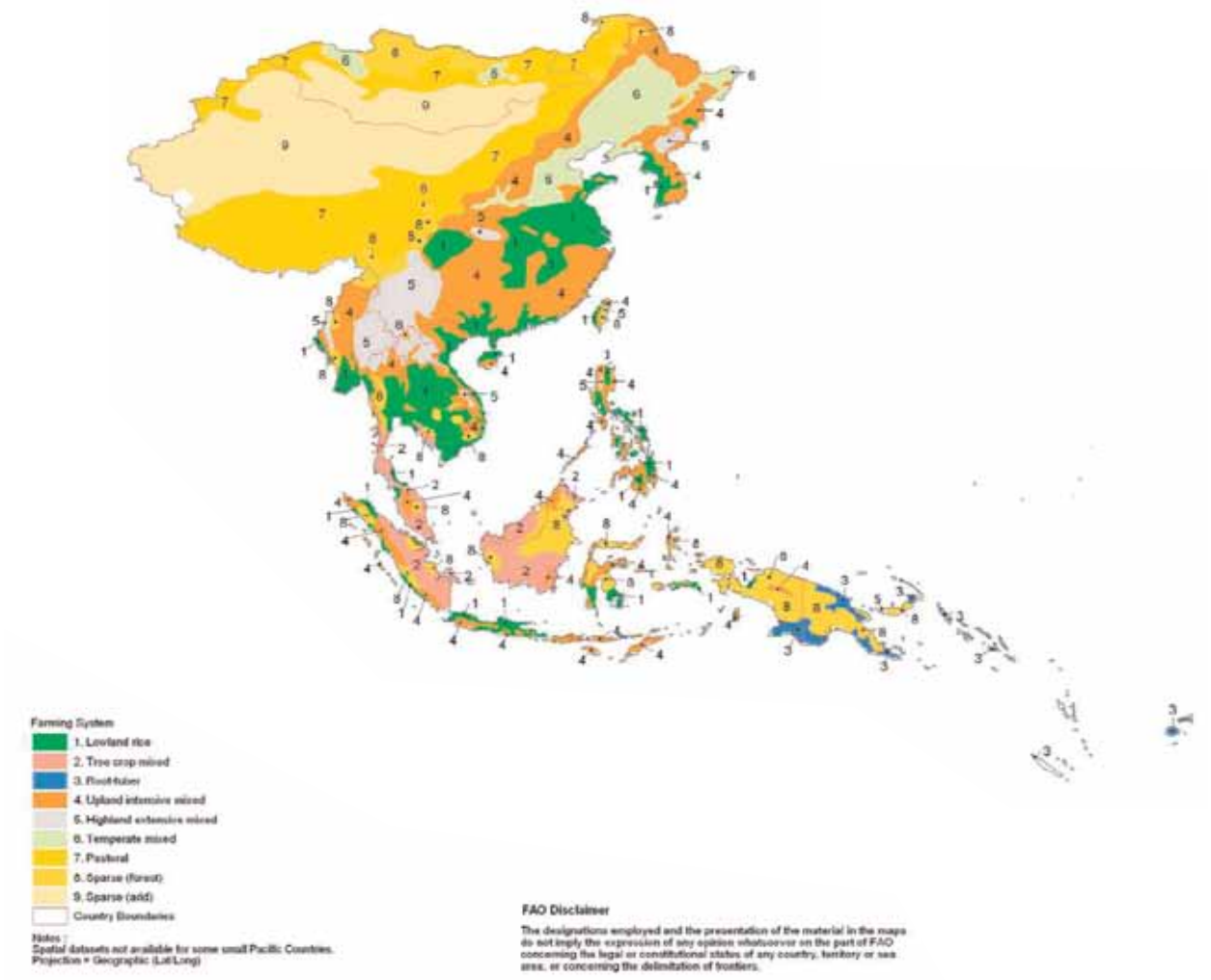
FAO Disclaimer

The designations employed and the presentation of the material in the maps do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

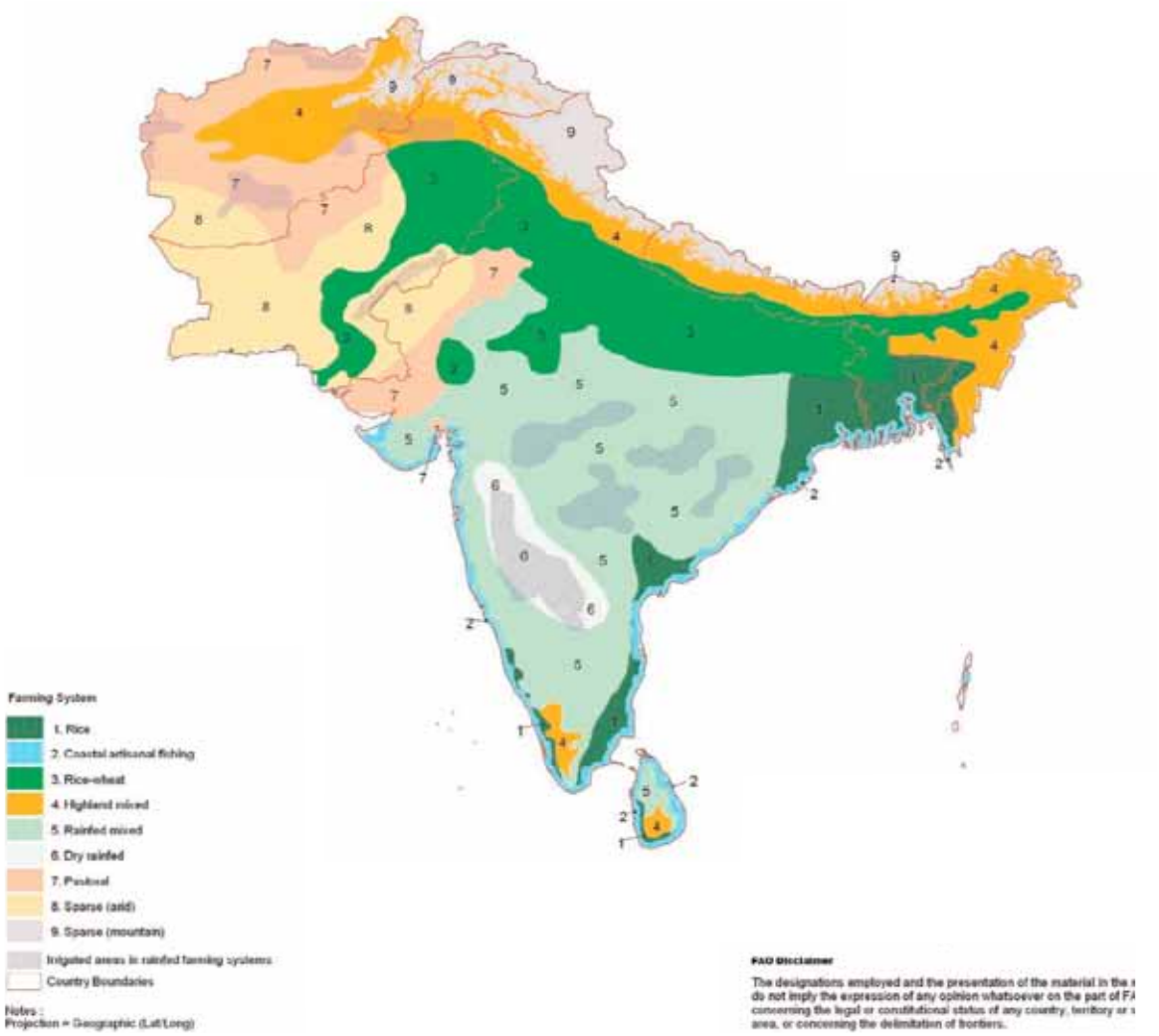
Notes :
Projection = Geographic (Lat/Long)

Farming System
1. Irrigated
2. Mixed
3. Forest based livestock
4. Horticulture mixed
5. Large scale cereal-vegetable
6. Small scale cereal-livestock
7. Extensive cereal-livestock
8. Pastoral
9. Sparse (cold)
10. Sparse (arid)
Water Bodies
Irrigated areas in rainfed farming systems
Country Boundaries

Major Farming Systems **East Asia Pacific** Map 1



Major Farming Systems **South Asia** **Map 1**



Appendix 4: Ethno Foods and Food Culture Questionnaire

Conduct a Focus Group Discussion to develop a clear picture of how feeding decisions and eating events take place in the homes of community members.

Form #:_____.

Feeding and Food Culture Norms	
Who purchases household food?	
Who cooks the food?	
Who portions the food?	
Do all family members eat at the same time?	
Who eats first?	
Who eats last?	
Does anyone get a private plate?	
Are children under 5 actively fed?	
What weaning foods are used?	
When does weaning start?	
What foods are cooked for celebrations?	
What foods are everyday foods?	
What foods are eaten for sickness?	
Other relevant information mentioned	

Using the same Focus Group, compile a list of the majority of foods locally consumed, including drawings and photographs of each specimen, and collect samples for analysis at the food composition lab.

Ethno-food Data Collection Rubric	
This table should be used to record only products consumed by the community as food.	
Specimen #	
Specimen Name (Local)	
Specimen Name (General)	
Location (Village)	
Specimen Type (Fern, fungus, grass, mammal, reptile, bird, etc.)	
Habitat (Cultivated field, riverbank, forest, etc.)	
Elevation GPS Coordinates (X, Y)	
Photo #'s	
Drawing #'s	
Availability (Abundant, rare, endangered)	
Seasonality (Times of availability)	
Uses (Condiment, staple food, medicinal, etc.)	
Flowers (Describe flower shape and color)	

Flowering M (Enter flowering months)	
Fruit (Describe shape, color, and size of fruits)	
Fruiting M (Enter fruiting months)	
Harvesting Method (Describe the harvest process)	
State When Harvested (Raw, half-ripe, ripe, dry, etc.)	
Preservation Method (Ssun-drying, pickled, salting, etc.)	
Plant Parts Consumed (Stems, leaves, fruits, seeds, roots, etc.)	
Animal Parts Consumed (Milk, egg, organ meat, muscle, etc.)	
Product Collection Method (Milking, butchering, etc.)	
Preservation Method (Salted, dried, smoked, etc.)	
Folk Taxonomic Classification (Record name of category and other foods in the same category)What other foods is this food like?	
Health Conferring Properties (Aphrodisiac, cure for specific illness, immunity booster, etc.)	
Other Specific Characteristics (Food for a specific animal, temperature association, religious usage/association, etc.)	
Who should eat this food? Why?	
Who should not eat this food? Why?	
What happens if this food is overeaten?	
Date of Data Collection	
Name of Data Collector	
Special Notes	

Appendix 5: Agroecology Questionnaire and Data Collection Techniques

Form #:_____.

Community Level Agrobiodiversity Indicators		
Location:	**Elevation:**	
Village:	Number of Interviewees:	
Area/Region:	Date of Interview:	
State/Province:	Location of Interview	
Soil Type:		
Primary Cropping System:		
1. Number of families in the community:		
2. Number of farming families in the community:		
3. Number of farming families that own their land:		
4. Distance to the closest market:		
5. Available farming technology: (ex: tractors, harvesters, spraying equipment, etc.)		
6. Available farming infrastructure: (training, subsidies, agriculture extension workers, et c.)		
7. Farmer estimate of land amount used for household subsistence in food:		

Agricultural Products Available in the Study Area and Their Value						
Product Name	**Amount of land allocated to the product** (Average percentage of production/ farm household)	**Cropping Pattern** (Sole, dual, mixed, rotational, intensive multiple, intensive inter)	**Origin of Seed** (Self-saved, bought, borrowed, etc.)	**Animal Management Strategies** (Open grazing, fenced pasture, zero-grazing, etc.)	**Input cost by land unit** (Total- Separate chart can be used for breakdowns if deemed necessary)	**Harvest/Yield amount by land unit per year**
sheep						
maize						

Amount saved for household usage (From total harvest of indicated product for the year)	**Usage type** (Human consumption, animal consumption, household input, etc.)	**Storage Method** (include treatments, container, location)	**Loss to Storage** (Percentage of total harvest)	**Amount Sold** (From total harvest of indicated product for the year)	**Market price according to unit of measure**

Harvest Seasonality By Product in Research Community

Name of Crop	**Month Available** (Start at the first harvest date and draw a line through the subsequent months of availability)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sepr	Oct	Nov	Dec
Ex: Rice												
Ex: Salmon												

Input Cost Breakdown (Totals/Season)

Product Name	**Total**	**Herbicides**	**Fertilizers**	**Seed**	**Contracted Labor**	**Weeding**	**Ploughing**	**Irrigation**	**Harvest Equipment**

Farming Calendar:

Planting and Growth Cycle for Crops												
Crop Name	**Write in farming activity according to month and draw a line to indicate continuation of the activity in coming months.**											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ex: Rice		1st succession harvest		2nd succession planting		2nd succession harvest		3rd succession planting		3rd succession harvest		1st succession planting
Ex: Mango	Fruit Development			Harvest							Flowering	

Nutritional FD Outputs:

Name of Species Category	**Name of Each Species in the Category**	**Total Number of Species in Category**	**Percentage of Local Land Used in Production**	**Percentage of Total Consumption Produced Locally**	**Average Number of Species from Category Cultivated per Household**	**Richness Between Categories** (How many categories are there?)	**Evenness within Category** (How many species in this category?)
Pulses		16	43	80	7		

Appendix 6: Food Composition Charts

Food Composition Lab Results: Nutritional Values of Food Samples (100g Sample)																			
Name of Food	**Ingre-dients**	**Macronutrients**				**Minerals**							**Vitamins**						
		Protein	Carbohydrates	Dietary Fibre	Fat	Calcium (Ca)	Iron (Fe)	Potassium (K)	Magnesium (Mg)	Manganese (Mn)	Zinc (Zn)	Sulfur (S)	Vitamin A	Vitamin C	Tiamin	Riboflavin	Folate	Niacin	Vitamin B12	Vitamin D
Ex: Kichdi rice	rice																		
	Mung beans																		
	chilis																		

Appendix 7: Household Survey Questionnaire

Form #: .

Household Socio-Demographic, Health, Size and Food Security Measures	
Location	
Village:	Family Name:
Area/Region:	Name of Interviewee:
State/Province:	Head of Household (Y/N) Agroecology:
1. Do you own land? How many acres?	
2. What do you grow/harvest/raise?	
3. Percentage of total food intake self-produced	
4. Percentage of total food intake procured from local sources:	

Include all agricultural and wild products harvested by household members.			
Product Name	**Amount of land used**	**Amount harvested per season**	**Amount saved for food**
Ex: Goat milk	N/A- free open grazing	(0.5 liters/ goat/75 days) x 20 goats	Half of production
Rice	2 acres	60 kg	60 kg

Family Information:

Page 1	Name	Sex	Age	DOB	Marital Status	HOH	Birth-weight	Breast-fed	Educa-tion	Occu-pation	Edema	MUAC	Illness
		(M/F)	For under 5 list in months								(Y/N)	Children 5 and under only	(Past 7 Days) If yes, list ill-ness type, other-wise write N
1													
2													
3													

Page 2	Name	Weight 1	Weight 2	Weight Aver-age	Height 1	Height 2	Height Aver-age	Wast-ing	Wast-ing Z-Score	Stunt-ing	Stunt-ing Z-score	Under-weight	Under-weight Z-score	BMI
								Weight /height		Height / age		Weight /age		Weight/ height^2
1														
2														

24-hour Food Recall For the Household												
Name of Food	**Ingredients**	**Time of Day Consumed and Quantity (Associated or Non-Associated with typical mealtimes)**								**Food Sourcing**		
		Write in eating time starting on the left with the earliest time food was eaten, with quantity of food noted underneath in the corresponding column. Ex: 6 AM/ Early Morning	Who Ate?	10 AM						Source: grown, bought, gathered, traded, etc.	Percentage of food consumed self produced	Percentage of food consumed locally produced
Rice	N/A	1 cup	Moth-er only	7 cups	Whole HH							
Mango	N/A	1 small	Child 2 only	3 small	Father only							

* Locally relevant weights and measures should be developed by the survey team to appropriately quantify consumption amounts.

Finances:

What is your weekly/monthly income?

1. How much do you spend on food per day/week?
2. How much do you spend in total per day/week/ month?

Housing and Sanitation:

House characteristics/identifiers (OBSERVE, Don't Ask)	
Roofing material of household's main residence	1=grass/straw, 2=iron sheets, 3=tiles, 4=tin, 5=other (specify).....
Type of floor of household's main residence	1= tiles/wooden 2= cemented 3= earth floor
Type of wall of household's main residence	1= stone 2= wood 3=mud 4 = bricks 5=iron sheets

1. Does the household have access to a toilet? (Interviewer to **OBSERVE**)
   1= Yes
   2= No

2. If **yes**, what type of toilet does this household use?
   1= Flush
   2= Traditional pit latrine
   3= Ventilated improved latrine
   4= Others (specify)

3. How do you **mainly** dispose off your garbage?
   1= Burn
   2= Throw in garden
   3= Open Field
   4= Bins
   5= Composite pit
   6= Other (specify)

4. What is the **main** source of drinking water for this household?
   1= Piped inside the household
   2= Piped water in the compound
   3= Public tap
   4= Public well/borehole
   5= Shallow well/private well
   6= Rain water
   7= Pond/river/stream/dam
   8= Other 'specify'

5. Do you do anything to drinking water? 1=yes 2=No (if answer is yes, interviewer to **probe** for confirmation)
   If **yes**, what do you do?

   1= Boil
   2= Filter
   3= Boil and filter
   4= Sedimentation/decant
   5= Chlorination (use of water guard, aqua tab, pul etc).

6. When do you wash your hands? (**Tick all that apply**)

   1= Before food preparation
   2= Before eating
   3= Before feeding children
   4= After visiting the toilet
   5= After changing a child's nappies etc
   6= Other (specify)

7. Do you use soap to wash your hands? (Y/N)

Household Dietary Diversity Scale (HDDS)				
	To be completed based on the 24 hour food recall above, using multiple-pass for verification and accuracy.	**Foods** (list locally relevant examples)	**Consumption(Y/N)**	
CODE	Food groups, items and varieties consumed		Household	Index child
1	Cereals/grains and byproducts			
2	Vitamin A rich Vegetables and Tubers			
3	White Roots and Tubers			
4	Dark Green Leafy Vegetables			
5	Other Vegetables			
6	Vitamin A Rich Fruits			
7	Other Fruits			
8	Organ Meats			
9	Flesh Meats			
10	Eggs			
11	Fish and Seafood			
12	Legumes, Nuts, and Seeds			
13	Milk and Milk Products			
14	Oils and Fats			
15	Sweets			
16	Spices, Condiments, and Beverages			

Months of Adequate Household Food Provisioning (MAHFP)	
In the past year was there any time when your food supply was inadequate to meet the needs of your family?	**Y / N** (If yes, move on the next part of the chart. If no, finish recording this section)
In which months did you not have enough food supply to meet your family's needs?	**Y=1, N=0**
January	
February	
March	
April	
June	
July	
August	
September	
October	
November	
December	
Total of Y=1 is the MAHFP score	

Appendix 8: Anthropometric Measurement Techniques

More commonly used measurement combinations for children include:

Underweight: Weight for Age (identifies children who are underweight for age)

The advantage of weight for age measurements is that it provides information on both past (chronic) and present (acute) under-nutrition. Underweight can be used as an initial indicator of overall undernutrition, but must be corroborated by a calculation of stunting and wasting to ascertain whether the individual is suffering from chronic or acute undernutrition, or both.

Stunting: Height or *Length for age (identifies children with past or chronic malnutrition)

Height/Length for age measurements cannot be used to assess Short-term changes due to malnutrition because it takes a much longer period of deficiency for deficits in height to be manifested. When such deficits are observed they reflect stunting in children. Stunting is an indicator of past growth failure associated with a number of long-term factors such as chronic insufficient protein and energy intakes, frequent infection, sustained inappropriate feeding practices and poverty. Stunting, determined through height for age measurements can be used for evaluation in population studies but is not recommended for monitoring short-term progress during programme implementation because it generally does not change over a short nutritional intervention periods such as 6-12 months.

Wasting: Weight for Height or *Length (identifies children with acute under-nutrition or who are wasted)

Weight for height measurements identify children who are wasted or have acute under-nutrition, and are very useful in situations where the exact ages of children are unknown. Such measurements are particularly useful in population studies for assessing the effects of short-term trauma on children such as seasonal changes in food supply or nutritional stress brought about by extended illness.

Age

A child's age is required in order to accurately assess the nutritional status. Moreover, it is required for sampling, deciding on whether the child is measured standing or reclining for height or length, and for converting height and weight into the standard indices. Where documentary evidence of the birth date is available, recording of age is a straightforward procedure. However, in cases where birth certificates are not available, baptismal certificate or clinic records can be used to estimate the child's age. When these are not available, other methods have been used to estimate child's age, the most successful being the use of local calendars or events relevant and recognized in the community such as droughts, floods, important local festivals and even elections.

Weight

Equipment:

There are many types of scales currently in use. The UNISCALE (made by UNICEF) (Figure 9) has the following features:

- Solidly built and durable
- Electronic (digital reading)
- Measures up to 150 kg
- Measures to a precision of 0.1 kg (100g)
- Allows tared weighing

It is powered by a lithium battery that is good for a million measurement sessions. The scale has a

solar on-switch, so it requires adequate lighting to function. Footprints may be marked on the scale to show where a person should stand.

Measurement:
Explain to the mother the reasons for weighing the child, for example, to see how the child is growing, how the child is recovering from a previous illness, or how the child is responding to changes that have been made in his feeding or care.

If the child is less than 2 years old or is unable to stand, you will do tared weighing. Explain the tared weighing procedure to the mother as follows. Stress that the mother must stay on the scale until her child has been weighed in her arms.

Be sure that the scale is placed on a flat, hard, even surface. It should not be placed on a loose carpet or rug, but a firm carpet that is glued down is acceptable. Since the scale is solar powered, there must be enough light to operate the scale.

- To turn on the scale, cover the solar panel for a second. When the number 0.0 appears, the scale is ready.

- Check to see that the mother has removed her shoes. You or someone else should hold the naked baby wrapped in a blanket.

- Ask the mother to stand in the middle of the scale, feet slightly apart (on the footprints, if marked), and remain still. The mother's clothing must not cover the display or solar panel.

Remind her to stay on the scale even after her weight appears, until the baby has been weighed in her arms.

- With the mother still on the scale and her weight displayed, tare the scale by covering the solar panel for a second. The scale is tared when it displays a figure of a mother and baby and the number 0.0.

- Gently hand the naked baby to the mother and ask her to remain still.

- The baby's weight will appear on the display. Record this weight in the Visit Notes of the child's Growth Record. Be careful to read the numbers in the correct order (as though you were viewing while standing on the scale rather than upside-down).

Note: If a mother is very heavy (e.g. more than 100 kg) and the baby's weight is relatively low (e.g. less than 2.5 kg), the baby's weight may not register on the scale. In such cases, have a lighter person hold the baby on the scale.

Weighing a child alone:
If the child is 2 years or older, you will weigh the child alone if the child will stand still. Explain that the child will need to step on the scale alone and stand very still. Undress the child. Explain that child needs to remove outer clothing in order to obtain an accurate weight. Communicate with the child in a sensitive, non-frightening way.

- To turn on the scale, cover the solar panel for a second. When the number 0.0 appears, the scale is ready.

- Ask the child to stand in the middle of the scale, feet slightly apart (on the footprints, if marked), and to remain still until the weight appears on the display.

- Record the child's weight to the nearest 0.1 kg.

If the child jumps on the scale or will not stand still, you will need to use the tared weighing procedure instead.

Length or height

Equipment:

A length board (sometimes called an infantometer) is needed to measure length. This should be placed on a flat, stable surface such as a table.

A height board (sometimes called a stadiometer) is used to measure height. A good length or height board should be made of smooth, moisture-resistant (varnished or polished) wood. The horizontal and vertical pieces should be firmly joined at right angles. A movable piece serves as the footboard when measuring length or the headboard when measuring height. Unless there is a digital counter, a measuring tape should be fixed firmly in a groove along the length of the board, so that moving parts do not scrape it and rub off the markings.

Before Measuring

Be prepared to measure length/height immediately after weighing, while the child's clothes are off:

- Check that the child's shoes, socks, and hair ornaments have been removed.
- Undo braids if they will interfere with the measurement of length/height.
- If a baby is weighed naked, a dry diaper can be put back on to avoid getting wet while measuring length.
- If the room is cool and there is any delay, keep the child warm in a blanket until length/height can be measured.

Whether measuring length or height, the mother is needed to help with measurement and to soothe and comfort the child:

- Explain to the mother the reasons for the measurement and the steps in the procedure.
- Answer any questions that she may have.
- Show her and tell her how she can help you.
- Explain that it is important to keep the child still and calm to obtain a good measurement.

Measurement of Length:

A child's length is measured lying down (recumbent):

- If a child is less than 2 years old, measure recumbent length.

Cover the length board with a thin cloth or soft paper for hygiene and for the baby's comfort.

Explain to the mother that she will need to place the baby on the length board herself and then help to hold the baby's head in place while you take the measurement. Show her where to stand when placing the baby down, i.e. opposite you, on the side of the length board away from the tape. Also show her where to place the baby's head (against the fixed headboard) so that she can move quickly and surely without distressing the baby.

When the mother understands your instructions and is ready to assist:

- Ask her to lay the child on his back with his head against the fixed headboard, compressing the hair.

- Quickly position the head so that an imaginary vertical line from the ear canal to the lower border of the eye socket is perpendicular to the board. (The child's eyes should be looking straight up.) Ask the mother to move behind the headboard and hold the head in this position.

Speed is important. Standing on the side of the length board where you can see the measuring tape and move the footboard:

- Check that the child lies straight along the board and does not change position.

Shoulders should touch the board, and the spine should not be arched. Ask the mother to inform you if the child arches the back or moves out of position.

- Hold down the child's legs with one hand and move the footboard with the other. Apply gentle pressure to the knees to straighten the legs as far as they can go without causing injury. Note: it is not possible to straighten the knees of newborns to the same degree as older children. Their knees are fragile and could be injured easily, so apply minimum pressure.

If a child is extremely agitated and both legs cannot be held in position, measure with one leg in position.

- While holding the knees, pull the footboard against the child's feet. The soles of the feet should be flat against the footboard, toes pointing upwards. If the child bends the toes and prevents the footboard from touching the soles, scratch the soles slightly and slide in the footboard quickly when the child straightens the toes.
- Read the measurement and record the child's length in centimeters to the last completed 0.1 cm in the Visit Notes of the Growth Record. This is the last line that you can actually see. (0.1 cm = 1 mm)

Remember: If the child whose length you measured is 2 years old or more, subtract 0.7 cm from the length and record the result as height in the Visit Notes.

Measuring Height:

- If the child is aged 2 years or older and able to stand, measure standing height.
- Place the measuring board on a hard flat surface against the wall, and ensure it is not moving
- The measurer must kneel with their right knee on the child's left side, which gives maximum mobility
- The child's feet must be flat and together in the centre of and against the back and base of the board. The child's legs must be straight and heels and calves against the board.
- The child must look straight ahead, shoulders are level, hands are at the child's side, and the head, shoulder blades and buttocks are against the board/wall
- The open left hand is placed under the child's chin, and with your right hand, lower the headpiece on top of the child's head, pushing through the child's hair.
- When the child's position is correct, the measurement is read and recorded.

In general, standing height is about 0.7 cm less than recumbent length. This difference was taken into account in developing the WHO growth standards used to make the charts in the Growth Record. Therefore, it is important to adjust the measurements if length is taken instead of height, and vice versa.

- If a child less than 2 years old will not lie down for measurement of length, measure standing height and add 0.7 cm to convert it to length.

- If a child aged 2 years or older cannot stand, measure recumbent length and subtract 0.7 cm to convert it to height (Cogill, 2003).

Mid-Upper Arm Circumference (MUAC)

Measurements of the MUAC are more commonly used for the rapid screening of acute malnutrition in children 6-59 months of age, and so it facilitates the determination of normal growth, or the presence/ onset of malnutrition. It is thus mainly used for detecting children in need of treatment rather than for measuring population trends. It is considered most appropriate in both emergency and non-emergency situations for identifying children that require immediate attention, and so is useful in crisis situations to quickly determine the need for nutrition intervention programmes (UNSCN, 2009).

Equipment:
MUAC Armband

Measurement:

- The individual needs to remove any clothing covering their arm

- The midpoint of the subjects' upper left arm is calculated: the tip of the shoulder is located using finger- tips and the elbow is bent to make a right angle. Place the tape at zero, which is indicated by two arrows, on the tip of the shoulder and pull the tape straight down past the tip of the elbow. Read the number at the tip of the elbow to the nearest centimetre. Divide this number by two to estimate the midpoint. The midpoint can be mark with a pen on the arm.

- The individual stands with arms straight and relaxed, and the tape is wrapped around the arm at midpoint. Make sure the numbers are right side up and that the tape is flat around the skin.

- The tape must have the proper tension- it can't be too tight or too loose

- When the tape is in the correct position on the arm with the correct tension, read and record the measurement to the nearest 0.1cm.

- Record the measurement in the Household Data chart. If the child is either in the red (SAM) or the yellow zone (Semi malnourished), advise the caregiver to give immediate attention to the child's diet and eating habits in order to immediately treat.

Oedema

Oedema is the presence of excessive amounts of fluid in intracellular tissue. It can be diagnosed by gently applying thumb pressure for three seconds to the back of the foot or ankle. Oedema is present if the impression of the thumb where the oedema fluid has been pressed out of the tissue remains for some time. The presence of this feature on both feet indicates oedema.

Oedema should be tested for after weight and height/length are measured (Cogill, 2003).

Body Mass Index (BMI)

Body Mass Index is another assessment tool that is used in nutritional anthropometry. It is a tool used more in older children and adults.

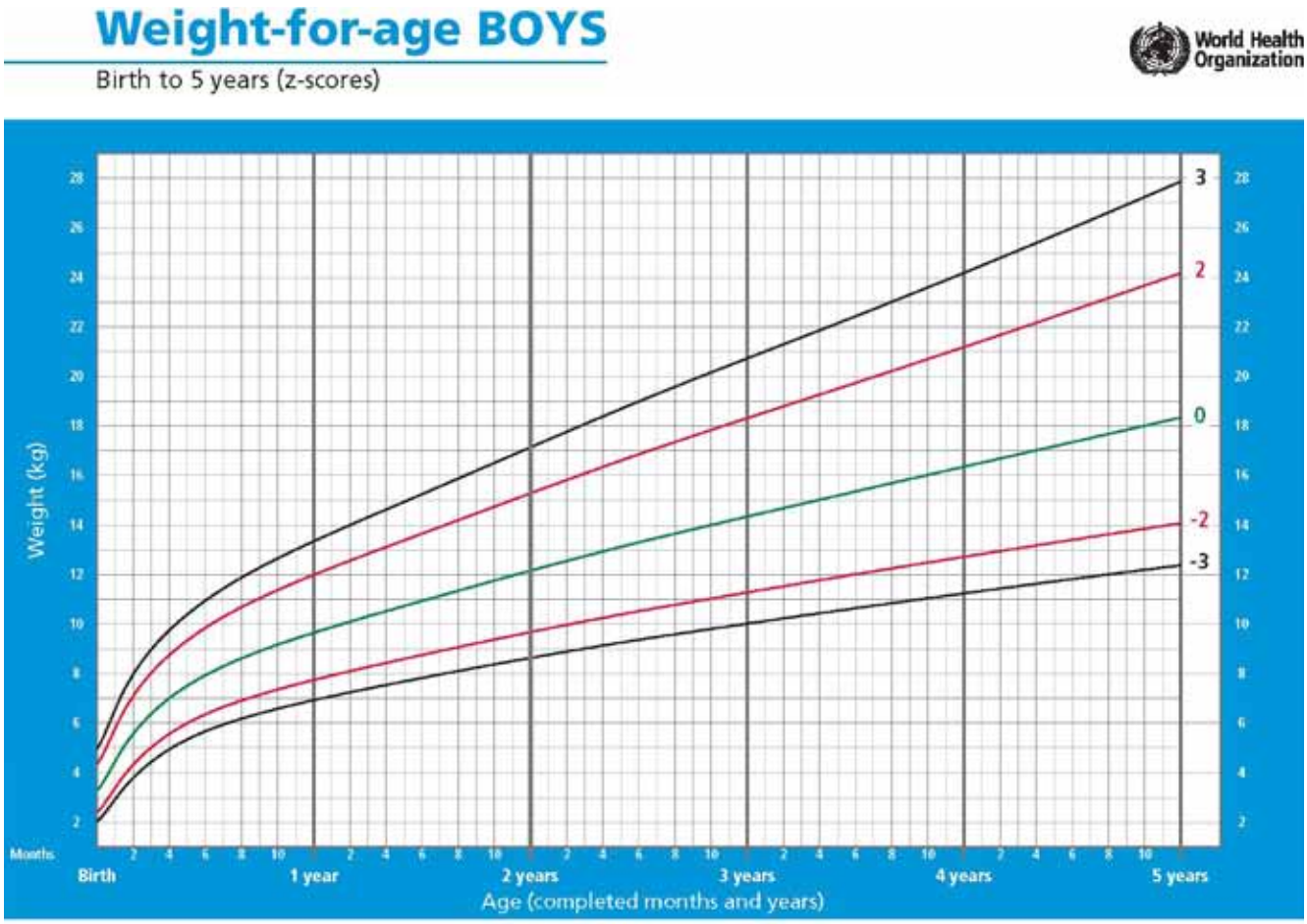
BMI is considered a reliable proxy measure of adiposity although body fat is not measured directly. It is an inexpensive and easy-to-perform method for screening for weight categories that constitute risk factors for certain diseases. BMI can thus be used to access health risks associated with overweight, and because of its simplicity, it has also been recommended as appropriate for population level assessments of chronic under nutrition (Collins et al, 2000). However, assessment of the latter should combine BMI and an estimate of the prevalence of famine oedema. BMI is the individual's weight divided by their height squared. During the survey data collection process, project facilitators should use the calculator to generate a BMI number and then use field charts to determine the BMI z-score.

Appendix 9: Examples of Growth Standard Field Charts

Weight-for-age GIRLS 5 to 10 years (z-scores)								
Year: Month	**Months**	**-3 SD**	**-2 SD**	**-1 SD**	**Median**	**1 SD**	**2 SD**	**3 SD**
5: 1	61	12.4	14.0	15.9	18.3	21.2	24.8	29.5
5: 2	62	12.5	14.1	16.0	18.4	21.4	25.1	29.8
5: 3	63	12.6	14.2	16.2	18.6	21.6	25.4	30.2
5: 4	64	12.7	14.3	16.3	18.8	21.8	25.6	30.5
5: 5	65	12.8	14.4	16.5	19.0	22.0	25.9	30.9
5: 6	66	12.9	14.6	16.6	19.1	22.2	26.2	31.3
5: 7	67	13.0	14.7	16.8	19.3	22.5	26.5	31.6
5: 8	68	13.1	14.8	16.9	19.5	22.7	26.7	32.0
5: 9	69	13.2	14.9	17.0	19.6	22.9	27.0	32.3
5: 10	70	13.3	15.0	17.2	19.8	23.1	27.3	32.7
5: 11	71	13.4	15.2	17.3	20.0	23.3	27.6	33.1
6: 0	72	13.5	15.3	17.5	20.2	23.5	27.8	33.4
6: 1	73	13.6	15.4	17.6	20.3	23.8	28.1	33.8
6: 2	74	13.7	15.5	17.8	20.5	24.0	28.4	34.2
6: 3	75	13.8	15.6	17.9	20.7	24.2	28.7	34.6
6: 4	76	13.9	15.8	18.0	20.9	24.4	29.0	35.0
6: 5	77	14.0	15.9	18.2	21.0	24.6	29.3	35.4
6: 6	78	14.1	16.0	18.3	21.2	24.9	29.6	35.8
6: 7	79	14.2	16.1	18.5	21.4	25.1	29.9	36.2
6: 8	80	14.3	16.3	18.6	21.6	25.3	30.2	36.6
6: 9	81	14.4	16.4	18.8	21.8	25.6	30.5	37.0
6: 10	82	14.5	16.5	18.9	22.0	25.8	30.8	37.4
6: 11	83	14.6	16.6	19.1	22.2	26.1	31.1	37.8
7: 0	84	14.8	16.8	19.3	22.4	26.3	31.4	38.3
7: 1	85	14.9	16.9	19.4	22.6	26.6	31.8	38.7
7: 2	86	15.0	17.1	19.6	22.8	26.8	32.1	39.2
7: 3	87	15.1	17.2	19.8	23.0	27.1	32.5	39.6
7: 4	88	15.2	17.3	19.9	23.2	27.4	32.8	40.1
7: 5	89	15.4	17.5	20.1	23.4	27.6	33.1	40.6
7: 6	90	15.5	17.6	20.3	23.6	27.9	33.5	41.1

Year: Month	Months	-3 SD	-2 SD	-1 SD	Median	1 SD	2 SD	3 SD
7: 7	91	15.6	17.8	20.5	23.9	28.2	33.9	41.5
7: 8	92	15.7	17.9	20.7	24.1	28.5	34.2	42.0
7: 9	93	15.9	18.1	20.9	24.3	28.8	34.6	42.6
7: 10	94	16.0	18.3	21.0	24.5	29.1	35.0	43.1
7: 11	95	16.2	18.4	21.2	24.8	29.4	35.4	43.6
8: 0	96	16.3	18.6	21.4	25.0	29.7	35.8	44.1
8: 1	97	16.4	18.8	21.6	25.3	30.0	36.2	44.7
8: 2	98	16.6	18.9	21.8	25.5	30.3	36.6	45.2
8: 3	99	16.7	19.1	22.0	25.8	30.6	37.0	45.8
8: 4	100	16.9	19.3	22.3	26.0	30.9	37.4	46.3
8: 5	101	17.0	19.5	22.5	26.3	31.2	37.8	46.9
8: 6	102	17.2	19.6	22.7	26.6	31.6	38.3	47.5
8: 7	103	17.3	19.8	22.9	26.8	31.9	38.7	48.1
8: 8	104	17.5	20.0	23.1	27.1	32.2	39.1	48.7
8: 9	105	17.7	20.2	23.3	27.4	32.6	39.6	49.3
8: 10	106	17.8	20.4	23.6	27.6	32.9	40.0	49.9
8: 11	107	18.0	20.6	23.8	27.9	33.3	40.5	50.5
9: 0	108	18.1	20.8	24.0	28.2	33.6	41.0	51.1
9: 1	109	18.3	21.0	24.3	28.5	34.0	41.4	51.8
9: 2	110	18.5	21.2	24.5	28.8	34.4	41.9	52.4
9: 3	111	18.7	21.4	24.7	29.1	34.7	42.4	53.1
9: 4	112	18.8	21.6	25.0	29.4	35.1	42.9	53.7
9: 5	113	19.0	21.8	25.2	29.7	35.5	43.3	54.4
9: 6	114	19.2	22.0	25.5	30.0	35.9	43.8	55.0
9: 7	115	19.4	22.2	25.7	30.3	36.2	44.3	55.7
9: 8	116	19.5	22.4	26.0	30.6	36.6	44.8	56.4
9: 9	117	19.7	22.6	26.2	30.9	37.0	45.3	57.1
9: 10	118	19.9	22.8	26.5	31.2	37.4	45.8	57.8
9: 11	119	20.1	23.0	26.8	31.5	37.8	46.4	58.5
10: 0	120	20.3	23.3	27.0	31.9	38.2	46.9	59.2

2007 WHO Reference


Weight-for-age BOYS
Birth to 5 years (z-scores)
World Health Organization
Weight (kg)
Months
Birth
1 year
2 years
3 years
4 years
5 years
Age (completed months and years)
3
2
0
-2
-3
WHO Child Growth Standards

Appendix 10: Examples of Focused Intervention Strategies

Examples of agro-nutritional problems and potential interventions	
Issues to Address	**Proposed Solutions**
Lack of access to quality seed	Develop capacity for local seed production; increase sources of seed availability locally; etc.
Cash capital availability is low for agricultural startup costs, dietary supplementation, education, healthcare, transportation, and festivals.	Encourage partial cultivation of cash crops, with a focus on stability and market value, maintenance of adequate self-food production and gradual scaling up to compensate for delays in fruiting of perennial plants and trees.
Cultural behaviors regarding care and feeding of children keep food intakes low or breast milk production suppressed	Find exceptions to the rule in the community ("positive deviants") and use their example as a success with the same available resources. Use discussion and focus groups at all levels of family to encourage behavioral shifts for increased success.
Decline in knowledge/appreciation of the value of traditional foods and food processes	Affirmation of "modernized" values of these foods regarding agroecological health, physical health through nutrition, and market value to cultivate appreciation and renewed interest in production and consumption of these foods.
Cash cropping/ monocropping has compromised dietary variety and food availability	Integrated/ diversified cropping system agronomics should be taught and demonstrated, with emphasis on the decrease in risk, particularly for smallholders with the increase of diversification. Improved soil fertility and decreased input costs are benefits along with increased diet diversity.
Traditional food property taxonomy prevents the community from being interested in consuming larger quantities of a specific food of high nutritional value.	Promote usage of alternative foods or complimentary foods to balance the attributed effect of the food. Use innovators in the community to design new recipes incorporating desirable foods in acceptable ways.

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