

# The Use of Non-Standard Units for the Collection of Food Quantity

A Guidebook for Improving the Measurement of Food Consumption and Agricultural Production in Living Standards Surveys

Gbemisola Oseni, Josefina Durazo, and Kevin McGee



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World Bank

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The Living Standards Measurement Study (LSMS), a survey program housed within the World Bank's Development Data Group, provides technical assistance to national statistical offices in the design and implementation of multi-topic household surveys. Since its inception in the early 1980s, the LSMS program has worked with dozens of statistical offices around the world, generating high-quality data, developing innovative technologies and improved survey methodologies, and building technical capacity. The LSMS team also provides technical support across the World Bank in the design and implementation of household surveys and in the measurement and monitoring of poverty.

# ABOUT THIS SERIES

The LSMS Guidebook series offers information on best practices related to survey design and implementation. While the Guidebooks differ in scope, length, and style, they share a common objective: to provide statistical agencies, researchers, and practitioners with rigorous yet practical guidance on a range of issues related to designing and fielding high-quality household surveys. The Series aims to achieve this goal by drawing on the experience accumulated from decades of LSMS survey implementation, the expertise of LSMS staff and other surveys experts, and new research using LSMS data and methodological validation studies.

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## Living Standards Measurement Study (LSMS)

World Bank Development Data Group (DECDG)

[lsms@worldbank.org](mailto:lsms@worldbank.org)

[www.worldbank.org/lsms](http://www.worldbank.org/lsms)

[data.worldbank.org](http://data.worldbank.org)

Cover images: J. Durazo/World Bank; Ra Puji Wulandari Tungga Dewi/World Bank; Kevin McGee/World Bank  
Cover design and layout: Deirdre Launt

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# EXECUTIVE SUMMARY

This Guidebook is a reference for survey practitioners, providing advice on how to incorporate non-standard units (NSUs) of measurement into household surveys for the collection of food consumption and production quantities. Food consumption and agricultural production are two critical components for monitoring poverty and household well-being in low- and middle-income countries. Accurate measurement of both provides better contextual understanding and contributes to more effective policy design.

At present, there is no standard methodology for collecting food quantities. In many household surveys, respondents are forced to estimate quantities in standard or metric units, typically kilograms or liters. This method requires respondents to convert from whatever unit they actually consumed (e.g., a bowl of rice) to a standard unit. This conversion process is often an unfamiliar or difficult task for respondents and can introduce measurement error. We argue that allowing respondents to report quantities directly in NSUs places less of a burden on respondents and will ultimately improve the accuracy of the information they provide.

Despite these benefits, there are some challenges with this approach. First, these NSU quantities must still be converted into standard units for aggregation and analysis. Often, conversion factors are not readily available and must be created, a process that involves its own data-collection effort. A second challenge is that NSUs are by their nature not necessarily standardized across respondents. One person's "bunch" of bananas could be half the size of another person's "bunch." Showing reference photos of "bunches" to respondents can ensure that the unit "bunch" is further standardized when reported. This requires that a photo reference album is also prepared. This Guidebook explains how to properly incorporate NSUs into data-collection activities—from establishing the list of allowable NSUs to incorporating all components into household surveys. A NSU-focused market survey is a critical part of preparing the conversion factors required for effectively using NSU data in analysis work. As such, the bulk of this Guidebook focuses on implementing the market survey and on calculating conversion factors to ensure the highest-quality data when using NSUs.

## ***Practical guidance on non-standard units, conversion factors, and reference photos***

Although existing data must first be taken into consideration, establishing a baseline of properly documented NSUs will most often require conducting a market survey, whereby survey teams seek out item-unit combinations in the market to weigh and photograph. Both market outputs then become inputs to the main household survey: the reference photos are shown to respondents during interviews and the weights are used to create conversion factors that are applied to the reported NSU quantities, facilitating their use in data quality assurance and data analysis. Collectively, these components comprise what is referred to herein as the NSU library.

There are several important steps to follow in preparing the library: 1) Preparation—Plan the timing (relative to the main survey) and the locations of the market survey, prepare the necessary market-survey materials (instruments and manuals), and construct a list of item-unit combinations that will be allowed in the main survey; 2) Market survey implementation—Collect weights and reference photos, taking into account any sub-national variation; and 3) Data documentation for the main survey—Using the market data, create conversion factors for the NSUs and draft clear user protocols for enumerators (in terms of reference photos) and data users (in terms of conversion factors).

Procedures for properly implementing these steps are summarized here, and are then covered in detail throughout the Guidebook.

- a. In terms of planning and preparation, *a list of valid item-unit combinations should first be constructed by reviewing, updating, and supplementing as necessary any existing sources that contain information on common NSUs.* Next, when planning the market survey, it is especially important to consider its timing relative to the main survey where consumption and agricultural production data will be collected. *Ideally, the market survey should be conducted prior to the main survey in order to use the reference photos during the main survey.* If necessary, a much smaller-scale market survey can be conducted after the main survey to collect missing weights for any unanticipated conversion factors. Finally, *markets should be selected to ensure adequate coverage of NSUs in the relevant context.* This is particularly important if NSUs differ across regions.
- b. Following these preparatory steps and the detailed market-survey implementation guidelines herein will ensure that as many item-unit combinations are collected as possible, the weights collected are comparable and accurate, and the reference photos clearly demonstrate the actual size of the NSUs. Annex I contains sample survey instruments.
- c. After the market survey, the information collected should be prepared for use with the main survey. *A library of NSU materials should be compiled, starting with the calculation of conversion factors that can be applied to NSU consumption and production quantities collected during the main survey.* These conversion factors are used to flag unreasonable quantities for further verification; when surveys are conducted using computer-assisted personal interviewing (CAPI), this can be done during the course of fieldwork. When the main survey is complete, the conversion factors can be used to calculate total consumption, analyze poverty, etc. The library should also include *an album of reference photos compiled from the photos collected in the market survey.* This album should be used by the enumerators conducting the main survey to provide a reference size for NSUs. Finally, the library must include documentation of how the materials were prepared and how to properly use them during the main survey. We highly recommend that the library be made publicly available for use in other surveys in order to further standardize NSU reporting across data-collection efforts. The library can be continually updated as more information is collected.

Annex II to this Guidebook contains libraries for Ethiopia, Nigeria, Malawi, and Uganda, and is available online. Although they are targeted for use with LSMS-ISA surveys, the libraries are intended to be used by any researchers conducting similar survey activities in these countries. The libraries should be considered living documents, to be revised and updated with each new data-collection effort given that available foods and commonly used units and quantities may vary over time. Even so, making NSU libraries publicly available for more countries will make it easier to implement surveys that allow NSUs and will therefore result in improved data-collection for quantities of food consumption and agricultural production.



# I. Introduction

*Measuring poverty often depends on measuring food—food that is both purchased and harvested from the field. In low- and middle-income countries especially, food consumption still constitutes the largest share of total household consumption. As such, constructing a food poverty line and using it to estimate the total poverty line is the preferred methodology for measuring the share of households that are poor, which in turn is one of the most common welfare-analysis indicators for developing economies. Another important element of welfare analysis is the productivity of income-generating activities. In many low- and middle-income countries, agriculture is a major source of livelihood, and measuring agricultural productivity requires adequately measuring the quantity of agricultural output. Data on food quantity is also important for the computation of unit values for food items and crops, which in turn is critically important for monitoring and analyzing prices. Despite the importance of this information, accurately measuring both the quantity of food consumed and the quantity of agricultural output can be very challenging.*

## I.1 STANDARD VS. NON-STANDARD UNITS

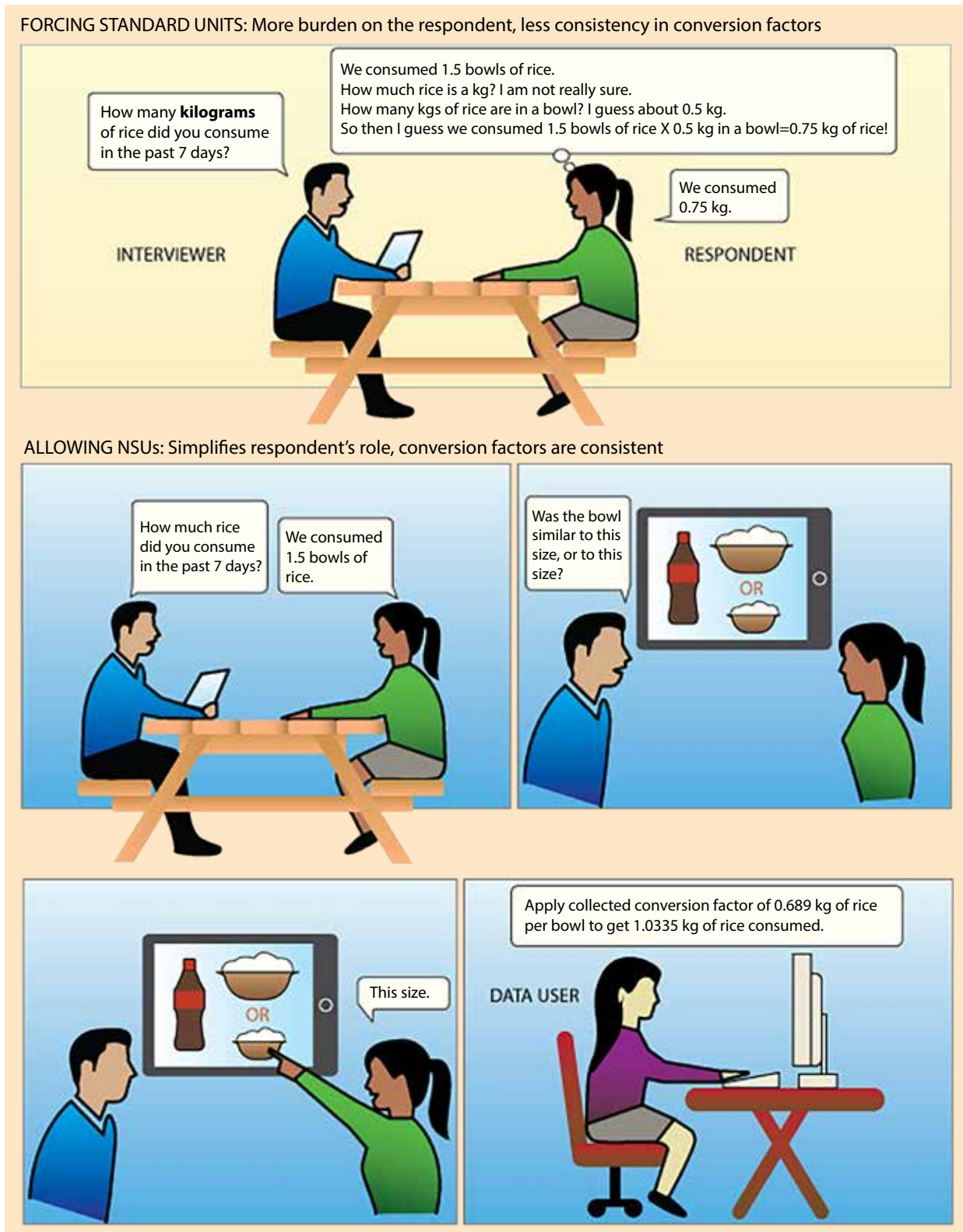
One important aspect of collecting information on food consumption and agricultural production is the choice of units in which respondents can report quantities. Many surveys require quantities to be reported only in “standard” units such as kilograms, pounds, liters, etc. In these cases, “local” or “non-standard” units are disallowed. Forcing respondents to report only in standard units simplifies the use of the data (since aggregation/analysis of food-item consumption often requires a common unit of measure) but it can impose a significant cognitive burden on the respondent, which in turn can reduce the accuracy of the resulting data.

Many respondents in low- and middle-income countries are more comfortable reporting their food consumption and production using familiar “local” or “non-standard” units instead of standard units. Forcing respondents to convert from these familiar units into standard units during an interview is a type

of cognitive task. Recent studies show that asking respondents to combine memory recall with cognitive tasks, such as abstracting consumption to a “typical week or month,” leads to less accurate self-reporting (Beegle et al., 2010).

The forced conversion from non-standard to standard units requires respondents to undergo the process depicted in Figure 1. Respondents 1) must have a good understanding of what a standard unit of a food item is (e.g., how much is a kilogram of rice), 2) must estimate how many standard units correspond to the NSU they know (e.g., how many kilograms fit into a cup of rice), and finally 3) using the conversion from 2, must calculate the quantity consumed in standard units (e.g., 1 cup of rice is about 0.5 kg, I consumed 1.5 cups of rice, so I consumed about 0.75 kg of rice). All three stages place a cognitive burden on the respondent and can lead to sizable measurement error. Allowing respondents to directly report consumption in NSUs would ease the burden on the respondents and will ultimately result in more accurate reporting of their consumption.

Figure 1 — Forcing NSU Conversion vs. Allowing NSUs



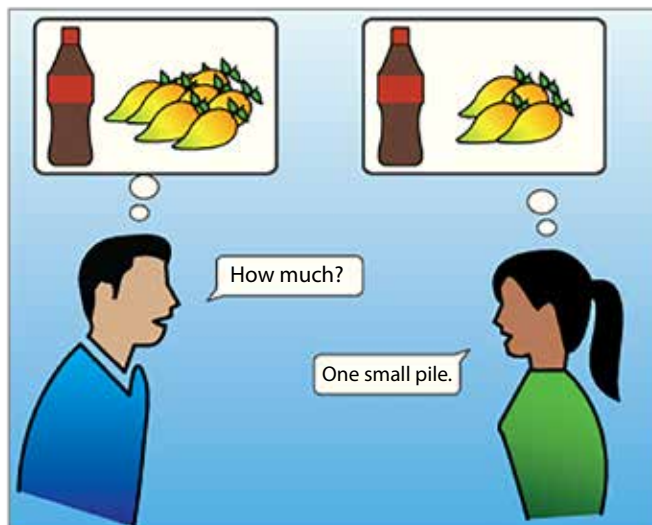
Source: World Bank, LSMS Team.

While allowing NSU reporting will eliminate some burdens for the respondent, it does not mean the issues of NSU conversion disappear. Instead, it falls to the survey or research team to acquire the necessary information to take NSU quantities from respondents and convert them to common standard units (i.e., undertake steps 1, 2, and 3 mentioned above). The most critical information required to make the conversions is a list of standard-unit conversion factors for each NSU as well as for each food item. These item-unit conversion factors can be applied to NSU quantities reported by respondents to convert them into standard units (typically kilograms and liters). In an ideal world, a list of such conversion factors would already exist for the relevant country or context. However, the current reality is that conversion factors are not readily available in many low- and middle-income countries. When they are available, they are often limited in scope or poorly documented, making their applicability and reliability hard to determine. When reliable conversion factors are not available, it is up to the national statistics agency or research team to collect the weights and calculate the conversion factors required to convert non-standard units into clearly and widely measurable standard units such as kilograms or liters.

Going about collecting the necessary information to properly incorporate NSUs into a survey and make NSU quantities usable for analysis is not a trivial process. The varied nature of NSUs introduces significant challenges to any survey or research team undertaking this task. For example, similarly named NSUs can vary significantly within countries or subnational regions. Even within the same locality, NSUs often come in more than one size (e.g. small, medium, large). The challenges are particularly significant for vaguely defined NSUs such as pieces, heaps, bunches, etc. A “heap” of tomatoes can vary dramatically in size, making it difficult to convert each respondent’s “heap” in a consistent and accurate manner. While these challenges are significant, there are no comprehensive guidelines on how to properly collect this information.

This Guidebook is meant to fill this gap by highlighting the necessary steps and best practices for collecting this information. Establishing a systematic, well-documented, and more precise set of conversion factors for non-standard units—and using it to both inform survey design and to convert reported measurements—will go a long way toward increasing the accuracy of crop-output estimates and household consumption. This in turn will allow for more informed policymaking on important development issues

Figure 2 — Vaguely Defined NSUs



Source: World Bank, LSMS Team.

such as household and individual welfare as well as agricultural productivity.

## 1.2 THE MARKET SURVEY

There are a few methods for calculating conversion factors. One such method suggested by Capéau (1995) and Capéau and Dercon (2006) is to compare unit prices using econometric techniques to estimate conversion factors. While this method is fairly simple to implement, it suffers from some drawbacks. Primary among these is that unit prices can vary because of factors unrelated to the actual mass or volume of an item. For example, unit prices can vary because of quality differences (Deaton 1997) or because of price discounts on larger units (Attanasio & Frayre, 2006).<sup>1</sup> In addition, unlike conversion factors, prices can be subject to significant volatility due to market forces. These sources of variability in unit prices unrelated to mass or volume can result in distorted or imprecisely estimated conversion factors.

The main alternative method is to conduct a market survey where non-standard units are sought out and directly weighed. This is a more intensive process than calculating conversion factors from unit prices, but will likely result in more accurate conversion factors. When conducting a market

<sup>1</sup> Under this methodology, a numeraire unit price (usually kilograms or liters) is used to compare with other units. For larger units, there may be discount in the price per kilogram and thus applying the *numeraire* unit price would underestimate the conversion factor for larger units. The reverse is also true for smaller units.

survey, there are certain protocols that must be followed to ensure the collected weights are accurate and usable for creating conversion factors. For example, conversion factors for vaguely defined units (especially non-container units such as pieces, heaps, bunches, etc.) are most reliable when accompanied by *reference photos*. These photos can be shown to the respondents to provide standardized reference sizes for a “small heap” of onions, for example. Without the photos, the “small heap” reported by the respondent could be considerably different from the “small heap” used to establish the conversion factors (see Figure 2). These reference photos must therefore be taken and collected along with the weights.

### 1.3 THE MAIN SURVEY

Once all the requisite information is collected for proper implementation of NSUs in a survey, the interview process becomes much less taxing on the respondents, without additional burden on the enumerators. The bottom panel of Figure 1 depicts the revised process. The respondent is only required to think about consumption or production in the unit with which she is most familiar. The enumerator simply confirms this unit using the reference photo and then records the amount in NSUs. Afterward, conversion factors are applied to the reported NSUs to arrive at the correct standard weight.

### 1.4 THIS GUIDEBOOK

This Guidebook serves as a reference for preparing and using non-standard units: establishing a list of valid NSUs, collecting standard weights and reference aides for NSUs (usually via a market survey), calculating conversion factors from these weights, and incorporating NSUs into household and agriculture surveys. It also provides a library of local units, conversion factors, and photographic aids for selected countries. The Guidebook is structured as follows. Section 2 provides background on non-standards unit (NSUs), discusses the importance of properly quantifying household consumption and production, and offers various methods of collecting this data. The section also details the benefits and challenges of NSUs and documents their use in the Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) implemented by the LSMS team of the World Bank. Section 3 outlines the components of a high-quality NSU library as well as the necessary procedures for conducting a market survey to collect the components of the library. Section 4 discusses some of the important

benefits that are derived from utilizing CAPI survey methods to both collect and use information contained in a NSU library. Section 5 offers concluding remarks. Annex I provides a set of sample instruments for collecting and then using NSUs. Annex II is available online and provides libraries of NSU conversion factors from four countries (Ethiopia, Malawi, Nigeria, and Uganda).

**THE LIVING STANDARDS MEASUREMENT STUDY-INTEGRATED SURVEYS ON AGRICULTURE (LSMS-ISA)** is a household survey project to foster innovation and efficiency in statistical research on the links between agriculture and poverty reduction in the region. Recognizing that existing agricultural data in Sub-Saharan Africa suffers from inconsistent investment, institutional and sectoral isolation, and methodological weakness, the LSMS-ISA project collaborates with the national statistics offices of its eight partner countries to design and implement household surveys with a strong focus on agriculture. In each partner country, the LSMS-ISA supports multiple rounds of a nationally representative panel survey with a multi-topic approach designed to improve the understanding of the links between agriculture, socio-economic status, and non-farm income activities. The frequency of data collection is determined on a country-by-country basis, depending on data demand and the availability of complementary funding.

## 2. Methodologies for Reporting Consumption and Production Quantities

*Food consumption and agricultural production are two of the most important measurements in living standards surveys as well as in many other household surveys in low- and middle-income countries. Food consumption is the primary component for many measures of poverty, nutrition, and food security. Information on agricultural production provides important insights on agricultural performance as well as farm household income and own-food consumption. The critical importance of consumption and agricultural production quantities has led to the development of several different measurement methodologies. Each method has its merits and drawbacks and is not necessarily applicable in all situations. However, we argue that the use of non-standard units to measure quantity is widely applicable and strikes a fair compromise in terms of cost.*

### 2.1 COLLECTING DATA ON FOOD CONSUMPTION

The various methods of collecting food-consumption data are the subject of a large and well-established body of literature. In general, consumption information is typically collected via respondent recall interviews or a consumption diary. For recall, respondents are asked to estimate their consumption of an item over a specified period, typically seven days. Under the diary method, respondents are asked to keep a daily diary of their consumption. Both methods require respondents to report quantities of food consumed. Though there is a broad range of survey-design issues (see Beegle et al., 2010 for a review of these issues), the discussion here will focus on collecting quantities, as this is the specific design focus of this Guidebook.

There are many methods used to collect information on the quantity of food consumed in a household survey. Smith & Subandoro (2007) discuss seven primary methods, summarized as follows:

1. Metric (i.e., standard) units: Respondents report quantities in metric units such as kilograms or grams. While this method is low cost and relatively easy to record, it can result in inaccurate estimates in some circumstances (see below).
2. Monetary value: Respondents estimate the monetary value of the quantity consumed or produced. This method requires additional collection of metric prices in order to estimate quantities, which can also be subject to significant errors.
3. Local (i.e., non-standard) units: Any unit of measurement that does not have an objective, universal metric or standard weight. This includes items such as “pail,” “basket,” or “pieces;” the latter is discussed in #4 below.
4. As in #3, respondents report quantities in terms of non-standard units with which they may be more familiar. These methods ease the burden on the respondent (in terms of memory recall and conversion calculations), but can increase the cost of survey implementation.

5. Volumetric equivalents: Respondents demonstrate how much space the food they consumed would take up. Conversion factors would need to be applied to convert to metric units.
6. Linear dimensions: Respondents provide linear measurements (length and width or circumference) of the amount of food consumed. As Smith & Subandoro (2007) point out, this method likely takes more time to complete as it requires physical measurement rather than a simple vocal response.
7. Food models: Respondents choose a two- or three-dimensional depiction of a food item that best corresponds to their consumption amount. This method can provide very accurate estimates, but it can be costly to prepare the models and calculate their weights.

While one method may be optimal for certain items, it may not be feasible or appropriate for others. Smith & Subandoro (2007) advocate using a combination of these methods. This Guidebook and the accompanying library will focus on four of these methods, which are complementary and comprehensive: metric units, local units, including a count of pieces, with some two-dimensional depictions (i.e., reference photos). Joint use of these four methods will minimize the burden on the respondent as well as on the enumerator, although it may require additional costs beyond the main survey visit.

## 2.2 COLLECTING DATA ON AGRICULTURAL PRODUCTION

There are three prevailing methods for measuring agricultural production: farmer recall, whole plot harvest, and crop cutting (Sud et al., 2016). Under the recall method (as with recall for food consumption), farmers estimate how much of a particular crop they have harvested since a certain date. Both whole plot harvest and crop cutting are much more labor-intensive processes that attempt to eliminate the subjective bias or error inherent in farmer estimates. Under the crop-cutting method, a portion of a farmer's crop is cut and measured by enumerators at the time of harvest. However, there are some potential sources of bias that arise in the crop-cutting method (Fermont & Benson, 2011). Whole plot harvest is similar to the crop cutting method, but the output of the entire plot is cut and measured. This is considered the most accurate yield measurement, but is also extremely

costly to implement on a large scale. While there are numerous issues associated with all three of these methods, they are largely beyond the scope of this Guidebook (see Fermont & Benson, 2011 and Sud et al., 2016 for a review). The focus here is on the collection of harvest quantities.

In principle, many of the consumption-quantity collection methods outlined by Smith & Subandoro (2007) are also applicable to the collection of agricultural-production quantities. However, there is one additional issue that is specific to the measurement of crop harvests. The condition of the crop—threshed, shelled, fresh, dried, etc.—can have a large impact on reported harvest quantities (Fermont & Benson, 2011; Diskin, 1999; Murphy et al., 1991). The weight difference is either due to discarding a portion of the crop via threshing, shelling, or peeling, or is the result of a change in moisture content through drying. These processes are particularly important for cereals and legumes, which are quite often processed before being used or sold. It is therefore important to ensure that when a harvested quantity is reported, the condition of the crop to which the quantity refers is also specified. When quantities are reported for various conditions, additional condition-specific conversion factors can be applied to render the quantities comparable.

## 2.3 IMPORTANCE OF NON-STANDARD UNITS IN HOUSEHOLD SURVEYS

The methodological issue that is the focus of this Guidebook is the use of non-standard units in the collection of consumption and production quantities. But what exactly are “non-standard” versus “standard/metric” units? Both standard and non-standard units are commonly used in markets or by households in many countries. Standard units are universally constant, referring to a clearly defined weight and/or volume. A kilogram in Uganda is the same as a kilogram in France. Likewise, a kilogram of maize is the same weight as a kilogram of wheat. For the most part, “standard” encompasses metric units, imperial measurements, and other internationally standardized units that are easily converted into metric units. For example, the conversion between kilograms and pounds is constant regardless of region or item.

In contrast to standard units, non-standard units (NSUs) often vary greatly from item to item, region to region, and even village to village. Table I presents examples of some common standard units and NSUs.

**Table 1 — Examples of Standard and Non-Standard Units**

Standard	Non-standard	
	Common	Local (Uganda)
Kilograms	Sack	Jerrican
Grams	Bunch	Kimbo/Blueband tin
Liters	Heap	Nido tin
Centiliters	Piece/number	Cup/mug
Pounds	Bucket	Nice cup
		Crate
		Plastic basin

Source: World Bank, LSMS Team.

Some NSUs are common across many locations. For example, throughout the world, bananas and other items are often measured in bunches. While this NSU is common, it is not standardized. The number and size of the bananas that are in a bunch are not standard; one bunch of bananas could be three times the size of another bunch. Likewise, a bunch of bananas is not equivalent to a bunch of herbs. The same is true for pieces, heaps, and other units. In addition to these common NSUs, there are also NSUs that are specific to a country or region. Table 1 includes several NSUs commonly used in Uganda (far right column). Many of these units are locally familiar containers of a standard volume; however, the weight of the contents will vary depending on the item. For example, a Nido tin of rice does not weigh the same as a Nido tin of groundnuts. The use of local units can vary significantly within a country. As an example, Table 2 presents the distribution of local units in Nigeria observed

in the second wave of the General Household Survey Panel (GHS-Panel) for each of the six geopolitical zones. Only one unit (milk cup) is common to all six zones. Most units are only found in two to three zones and are rarely or never observed in others. These complexities associated with NSUs create some challenges relative to standard units. However, there are additional factors that contribute to the relative merits of the methods, detailed further below.

## 2.4 NON-STANDARD UNITS IN HOUSEHOLD SURVEYS

### BENEFITS OF ALLOWING REPORTING IN NON-STANDARD UNITS

There are trade-offs involved in deciding whether to allow respondents to report quantities in NSUs or to restrict respondents to reporting in only standard units. Although NSUs are subject to significant variation, there are tangible benefits to allowing respondents to report in NSUs. The most important and overriding benefit is that respondents will likely be better able to estimate quantities using NSUs. In rural areas especially, standard units may not be commonly used in markets and respondents may not regularly use standard units in their daily activities. Even though respondents may know exactly what a kilogram of sugar looks and feels like (a very common sales unit for sugar), they may not know this for cassava, maize, or other items that are not typically traded in kilograms at the household level. Likewise, many items are not generally consumed in standard units. Often, fruit is sold by the piece instead of by weight; herbs are

**Table 2 — Regional Variation of NSUs in Nigeria**

	% of all NSU Observations in Zone					
	North Central	North East	North West	South East	South South	South West
Mudu	56.7	62.4	17.4	0.0	0.7	0.0
Olodo	0.0	0.0	0.0	0.0	14.0	0.0
Congo	7.5	0.0	0.0	0.0	0.0	47.9
Paint rubber	3.9	0.2	0.6	12.1	0.0	2.7
Derica	0.4	1.3	0.2	2.5	16.1	13.8
Milk cup	27.3	8.9	21.4	21.6	42.6	28.8
Cigarette cup	0.5	0.0	0.1	60.7	22.3	0.0
Tiya	0.0	26.7	58.5	0.0	0.0	0.0
Kobiowu	2.8	0.0	0.0	0.0	0.0	0.0

Note: Shaded cells = Units rarely/never observed in that zone.

Source: World Bank, LSMS Team.

sold by the bunch, regardless of weight variation; and home-grown fruits or vegetables are harvested and eaten without being weighed. When respondents are more familiar with NSUs for specific items, it may be too burdensome to expect them to know that item in terms of standard units.

Forcing respondents to report quantities in standard units often combines two self-reporting styles, each with its own potential for error: memory recall and cognitive reasoning. Household consumption modules typically ask respondents to recall a litany of food items eaten by numerous household members over a given period. Farming households are asked to recall and report on a variety of different crops harvested over a given period. The latter case is further complicated by the fact that key crops throughout the region (e.g., cassava, maize, and plantains) are typically harvested in small quantities on a continual basis.

Both memory recall and ad-hoc unit conversions also require mathematical calculations that, while not necessarily complicated, are prone to errors when done in the field and on the fly—even more so when considering respondent and enumerator fatigue. Combining memory recall with unit conversion increases the number of calculations required of the respondent for each value, which further increases the potential for error (as shown in Figure 1). In general, allowing respondents to report in the units they can most easily quantify simplifies memory recall and will yield estimates that are more accurate.

## CHALLENGES OF ALLOWING REPORTING IN NON-STANDARD UNITS

Although there is a strong case for allowing respondents to report in NSUs, many surveys of consumption and agricultural production still restrict respondents to reporting amounts in standard units. This is primarily due to the additional cost and challenges associated with properly implementing and operationalizing NSUs in a survey. The complexity of NSUs as well as the additional steps required for their use can increase the financial and temporal burden of conducting a survey. The challenges associated with using NSUs broadly fall into two categories: (1) those associated with the preparation and implementation of the survey with NSUs, and (2) ensuring NSU measurements can be converted into comparable standard units.

One of the first challenges that survey designers face is identifying the units to be included in the survey. When respondents are limited to reporting in standard units, compiling the code list is straightforward. However, compiling a list with non-standard units requires additional information about the common NSUs in the relevant country and/or regions. When such information is limited or not available, it will need to be collected via a market survey.

In addition to identifying the NSUs to include in the main survey, survey designers also need to ensure the clarity of the unit definitions. Some of the most common units that fall into this category are pieces, bunches, or heaps. For example, a piece of sweet potato could weigh 0.5 kilograms or 1.5 kilograms. Figure 3 below illustrates this problem: the pictured containers vary significantly in size but are all called *dengu* in Malawi. In order to obtain the most accurate estimates for these units, respondents should be provided with a reference frame for the quantity. One way to do this is to provide respondents with reference photos for these items. This resource can also be produced as part of the market survey and requires additional enumerator training (detailed below).

Figure 3 — Wide Variety of *Dengus* of Tomatoes in Malawi



Source: World Bank, LSMS Team.

The final and most significant challenge in using NSUs is that they must be accompanied by standard-unit conversion factors. In their raw form, quantities in NSUs are not comparable across units. To directly compare and aggregate quantities, the data user must convert all quantities into a common standard unit such as kilograms. Converting between



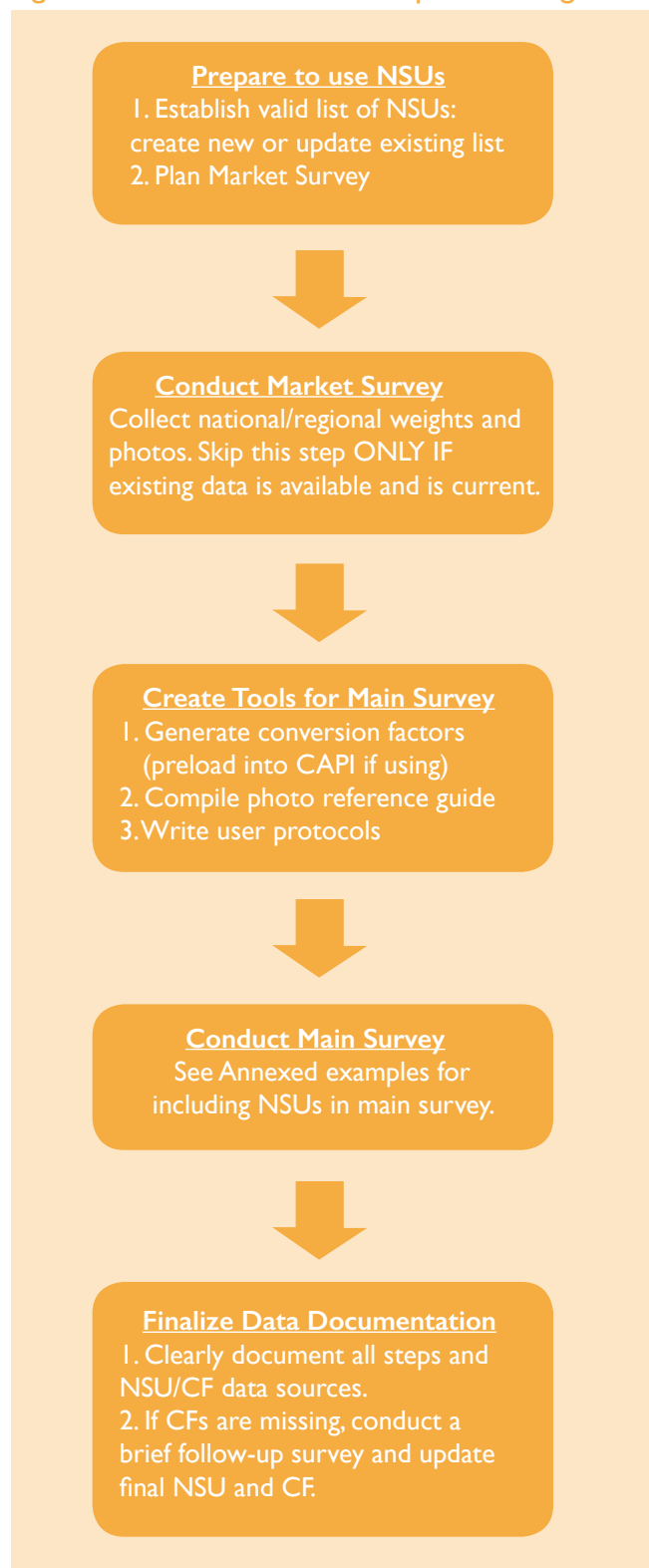
standard units is relatively easy since the conversions are constant and well known. However, for NSUs, the conversion is different for each unit and often for each item. Complicating matters further, the standard weight for the same item-unit combination can vary, even within a country. For example, one study in Nigeria found that an average bundle of sorghum weighed between 26 and 49 kilograms depending on the area (Casley & Kumar, 1988). When this is the case, region-specific conversion factors should be acquired.

### HOW COMMON ARE NON-STANDARD UNITS IN SURVEYS?

In low- and middle-income countries, especially in Africa, NSUs are used quite regularly for the most important items. At markets in these countries, consumers encounter a wide variety of NSUs for their purchases. In addition, when given a choice between reporting quantities in standard or non-standard units, respondents often choose to report in NSUs. For example, in the second wave of the Ethiopia Socioeconomic Survey from 2013/2014 when NSUs were allowed, nearly 50 percent of farmers chose to report their harvests in NSUs. In the Malawi National Panel Survey, respondents chose NSUs about 73 percent of the time. This provides a strong indication that many respondents are more comfortable reporting quantities in NSUs.

While the challenges associated with including NSUs in a consumption or agricultural production survey can be significant, this Guidebook provides detailed instructions to help survey designers incorporate NSUs into their surveys.

Figure 4 — Recommended Steps for Using NSUs



Source: World Bank, LSMS Team.

# 3. Guidelines and Procedures for Capturing and Using Non-Standard Units

*This section lays out the necessary steps and procedures required to collect the information necessary to implement and use NSUs in household surveys. Before NSUs can be used, a resource library for NSUs will need to be prepared. This library should include (1) a list of common/allowable NSUs; (2) national or regional conversion factors for all item-unit combinations; (3) a photo reference album based on an index of NSUs; and (4) clear protocols for using conversion factors and reference photos in agricultural and household surveys. The best way to collect the information for the library is to conduct a market survey to capture reference photos and the item-unit weights used to calculate conversion factors. In countries where surveys already allow reporting in NSUs, existing data (once updated, if need be) can complement the library. Taken together, these components will help researchers to adopt the use of NSU reporting; for countries with libraries provided in this Guidebook, the cost/burden of adoption is significantly eased. These libraries should not be treated as fixed, but should instead be continually updated with new NSUs and conversion factors.*

There are several important steps to follow when collecting the components for an NSU conversion-factor library (see Figure 4): 1) Preparation—Plan the timing (relative to the main survey) and the locations of the market survey, prepare the necessary market-survey materials (instruments and manuals), and construct a list of item-unit combinations that will be allowed in the main survey; 2) Market survey implementation—Collect weights and reference photos, taking into account any sub-national variation; and 3) Data documentation for the main survey—Using the market data, create conversion factors for the NSUs and draft clear user protocols for enumerators (in terms of reference photos) and data users (in terms of conversion factors). Each of these steps is covered in detail here.

## 3.1 MARKET SURVEY PLANNING AND PREPARATION

### TIMING OF MARKET SURVEY

The data-collection schedule for the market survey should take into consideration the seasonal availability of items and existing data-collection schedules in each country. In some cases, market-survey data collection should be planned for two separate periods to ensure more complete coverage of seasonally available items. In general, the greatest variety of items and the greatest variety of crop conditions will be available during the harvest season, though some items may only be available during the lean season or after a secondary harvest season.

The timing of the market survey relative to the main survey is important. Performing the market survey before the main survey (*ex-ante* or independently) has several advantages. First, reference photos can be taken and then used during the main survey, and conversion factors can be used to validate reported quantities during fieldwork, both helping to ensure more accurate NSUs estimates. Second, conducting the market survey *ex-ante* allows for the identification of additional NSUs that may be missing from any existing list of answer options. Identified in advance, these units can be incorporated into the unit list for the main survey.

However, there are also some drawbacks to conducting the market survey before the main survey. The primary one is that new units not included in the market survey could be reported in the main survey. When the market survey is performed after the main survey (*ex-post*), the unit list for the market survey can be constructed to include all item-unit (and item-unit-conditions) observed in the main survey, thus limiting any conversion-factor gaps.

Given these considerations, the ideal plan is to conduct two market surveys—one before and one after the main survey. Both market surveys need not be equally rigorous; one will likely be more comprehensive than the other. For example, the *ex-ante* survey could be limited, aiming to collect reference photos and weights (for conversion-factor calculations) for the most common NSUs, while the *ex-post* survey could comprehensively collect weights for all additional NSUs reported during the main survey. Or the *ex-ante* survey could be intensive, aiming to collect as many conversion-factor weights as possible—especially when conducted independently—while the *ex-post* survey could be limited to collecting only those unanticipated item-unit combinations. In general, the intensive version of the market survey should coincide with the season when the most items will be available in the markets.

Many household surveys already conduct market surveys as part of their fieldwork to collect current pricing information on commonly consumed items. When surveys allow NSU reporting, the market surveys could also collect actual weights of allowable NSU combinations that can be used to calculate standard-unit conversion factors. However, in such cases where the market survey is conducted in parallel with the main survey, reference photos would most likely not be available for use during interviews.

## SELECTION OF MARKETS TO VISIT

Three main factors will influence the selection of markets for the survey: 1) the degree of regional diversity of units

and their respective weights; 2) the relative timing of market surveys (as explained above); and 3) the types of markets frequented by sample households.

Markets should be selected to ensure adequate coverage of regional units and items. For market surveys conducted after the main survey, coverage can be assessed using the item-units observed in each stratum. The strata where the widest diversity of regional units is observed are prime candidates for the market survey. If the item-units were reported in the stratum, it is likely that measurements for that item-unit can be obtained from a market in that area. If the market survey is conducted independent of or prior to the main survey, adequate coverage must be assessed using external information on regional variations in units as well as information from the pilot survey (if conducted).

In many countries, households may patronize various types of markets, including local outdoor markets and small shops, supermarkets, wet markets, and wholesale markets. Markets selected for the survey should cover the full range of markets commonly used by households or farmers in the sample area.

In general, the number and dispersion of markets selected for the survey is highly dependent upon the context. For a nationwide survey in a large and diverse country like Ethiopia, it would likely be necessary to visit many markets across the country to ensure adequate coverage of NSUs, especially if the market survey is conducted during or after the main survey. However, for a market survey limited to a single region/state or community, visiting only a few markets may be sufficient.

## PREPARATION OF SURVEY MATERIALS

Once markets are selected, the survey materials (survey instruments and supporting manuals) can be prepared. While these materials should be designed according to the local context, Annex I includes examples from NSU-focused market surveys that were conducted to create the LSMS conversion-factor libraries for Ethiopia, Malawi, and Nigeria. Figure 5 depicts a snapshot of the market survey questionnaire for Ethiopia.

Though these survey instruments are specific to these countries, they also serve as examples of how to prepare instruments for any country/project. Each survey can collect the following key types of data:

- Market identification details: Name, location, GPS information, type of market, etc.

Figure 5 — Excerpt from a Market Survey Questionnaire

MODULE B: ITEM-UNIT MEASUREMENT - NONCONTAINERS										
1	2	3	4	5	6	7		8	9	
ITEM NAME	ITEM CODE	UNIT NAME	SIZE	Was item measured?	Why was item not measured?	Item Sample #1		Item Sample #2		Which type of scale was used?
				YES...1 (▶7)  NO..2	NOT FOUND IN MARKET AT THIS TIME.....1 CROP NOT COMMONLY FOUND IN THIS MARKET.....2 UNIT NOT COMMONLY FOUND IN THIS MARKET.....3 SIZE NOT COMMONLY FOUND IN THIS MARKET.....4 OTHER, SPECIFY.....5	Weight (KGs)	Price (Birr)	Weight (KGs)	Price (Birr)	PERSONAL DIGITAL SCALE.....1  MARKET SCALE WITH GOVERNMENT CERTIFICATION.....2  MARKET SCALE WITH-OUT GOVERNMENT CERTIFICATION.....3
ALL RESPONSES (▶ NEXT ITEM)										
CEREALS AND GRAINS										
BARLEY	1	ESIR	Small							
	1	ESIR	Medium							
	1	ESIR	Large							
	1	CHINET	Small							
	1	CHINET	Medium							
	1	CHINET	Large							
	1	SHEKIM	Small							
	1	SHEKIM	Medium							
MAIZE	2	PIECES	Small							
	2	PIECES	Medium							
	2	PIECES	Large							
	2	ESIR	Small							
	2	ESIR	Medium							
	2	ESIR	Large							
	2	CHINET	Small							
	2	CHINET	Medium							
MILLET	3	ESIR	Small							
	3	ESIR	Medium							

Source: World Bank, LSMS Team.

- Survey management information: Date, time, duration of surveys; codes for enumerator, supervisors, and (when applicable) data-entry staff.
- Data on pre-identified NSUs: Weights, prices, and basic metadata for common item-unit combinations that have been previously identified.
- Data on unexpected NSUs: Teams can collect the same type of data listed above for item-unit combinations that are not pre-defined, but that are present in the market. If such NSUs are commonly used in a regional market, it is likely that household survey respondents are purchasing,

and thus more readily able to report, in these quantities.

The Nigeria survey is split into two sections, allowing enumerators to more easily divide and share the data-collection work during each market visit. Detailed instructions on how to collect the data and complete the questionnaires are in the training manuals (also included in Annex 1).

### 3.2 CONSTRUCTING THE LIST OF NON-STANDARD UNITS

The first step in preparing the NSU library is to establish the list of common NSUs that will be used in the consumption and/

or production modules of the main survey. A list of common/allowable item-unit (and when applicable, item-unit-condition) combinations for NSUs should include a comprehensive set of valid NSU combinations for each crop and each food item. Where applicable, crop/food condition (e.g., corn in husk or not, peanuts shelled or unshelled, fresh vs. dried cassava) should be considered, especially for reporting harvested quantities, as the condition significantly impacts the weight-volume ratio. While it may be impossible to predetermine all the possible combinations, the library should endeavor to include combinations that represent the vast majority of options (preferably higher than 90 percent). Even when the same crops are grown and the same foods are consumed in different countries, it cannot be assumed that the same NSUs will be used in both places.<sup>2</sup>

The best practice for compiling this list would be for national statistics agencies to establish a conversion-factor library independent of any specific household survey, which can then be made available for use with any new survey within the country. Unfortunately, many low- and middle-income countries have no such source for NSU conversion factors; when they do, documentation and other supporting materials are often limited or lacking. When a conversion-factor library is available and well documented, household survey teams may choose to optimize timeline and budget constraints by using this existing resource. When such a library does not exist, or if existing conversion-factor data are limited or outdated, an NSU-focused market survey must accompany the household survey. Instructions for the market survey are discussed in detail in the next section. When implementing a market survey to fill these data gaps, the procedure for identifying the NSUs to include in the market survey will vary depending on the stage at which this step is performed.

## MARKET SURVEY BEFORE/ INDEPENDENT OF MAIN SURVEY

When the market survey is implemented before or independent of the main survey, the first step is to seek any information on common NSUs within the country. Identifying common NSUs and the items they apply to can be quite challenging, depending on the quality of information available to help guide selection. A best first source would be a comprehensive review of NSUs within a country. The libraries

annexed in this guidebook are intended to be such a source, but there may be additional reviews available, such as Kormawa & Ogundapo (2004) in Nigeria.

When comprehensive reviews are not available, the next preferred source for common NSUs will be other surveys already conducted in the country of interest that have allowed quantities to be reported in NSUs. These could be either household-level surveys with consumption or agricultural components, or market surveys. For these outside sources, the survey designer must consider the comprehensiveness of the NSU list. Some surveys may include only a few of the most common NSUs and exclude less common though important ones. Likewise, the geographic coverage of the survey also needs to be taken into account. For example, surveys that only cover a small area may not contain NSUs that are common in other areas of the country. Unless the selection of NSUs is clearly documented and comprehensive, the survey designer should seek additional information.

If resources and time permit, existing NSU lists can be validated with a small pilot survey to ensure the list is comprehensive and current. The pilot survey can either be at the household or market level. Performing a household-level pilot has the advantage of capturing consumption units used by households, which may differ from the units used in market transactions. However, conducting even a limited market-level pilot survey will allow for the collection of a wide array of item-units in a single market, whereas it may take several households to acquire a comprehensive list. The pilot survey should be largely open ended, allowing respondents (either household members or market vendors) to report in the units with which they are most comfortable or in the units that are most commonly available.

Many units may be available in different sizes, such as the array of *dengu* shown in Figure 2. In this case, simply listing *dengu* in the selected unit list would not sufficiently help standardize this NSU. When there is variation, the unit list should include the possibility of different sizes (e.g. small, medium, large) and the weights and reference photos for each size should be collected. This is particularly important for units such as pieces or heaps, which are subject to within-unit weight variation. When NSUs are coupled with reference photos depicting multiple measured sizes, it provides greater comparability across reported NSUs by standardizing the respondents' reference points. For example, if tomatoes are scarce in only one region, what is considered a "large tomato" may be equivalent to a small one elsewhere; by providing standardized photo references, the respondent can point to

2 Cross-country comparisons may be used to check the consistency of allowable item-condition combinations and to reconcile food-weight densities for common crops. This cross-country harmonization will be the focus of future work in this series.

“their” tomato, thus ensuring its weight is converted in a standardized way, regardless of local variation.

Note that a key benefit of conducting an *ex-ante* market survey and using photo references in the main survey is that much of the regional variation can be eliminated, which in turn limits the scope and burden of the market surveys to be conducted. Without the *ex-ante* collection (which allows for greater standardization with fewer measurements), you will need to collect and compare NSU data from markets in all regions to avoid under or over-reporting consumption across regions with different concepts of reference sizes.

### MARKET SURVEY AFTER MAIN SURVEY

For market surveys conducted after the main survey, the NSU list can be constructed based on the units observed in the data. Constructing the list *ex-post* can shorten the list of weights needed to exactly those necessary to make use of the data while ensuring there are no gaps in the eventual conversion-factor data.

When constructing the list of item-unit combinations, the data should be examined for combinations that are commonly observed. Invalid combinations should be excluded. Ideally, every valid item-unit as well as crop condition observed in the data should be included in the list of units for the market survey. However, if the list of observed item-units is extensive and/or resources for conducting the market survey are limited, then the item-unit list can be shortened. The most obvious method is to eliminate the least commonly observed item-units. This will depend greatly on the survey, but in general only very infrequently observed combinations should be dropped.

The extent of regional variation in reported NSUs should also be assessed to determine at what level the market survey should be conducted. This can be done by comparing common units at various geographic levels. If at most geographic levels the item-units are similar, then a national list can be constructed. However, if there is significant variation across regions, it may be more appropriate and feasible to disaggregate the item-unit lists to the regional level.

### 3.3 COLLECTING WEIGHTS FOR CONVERSION FACTORS

The two main purposes of the market survey are to collect weights in order to calculate conversion factors for consumption and production NSUs and to take reference

photos of item-unit combinations for respondent interviews. Although the procedure for collecting both these items may seem straightforward, strict protocols should be followed to obtain the most accurate conversion factors and produce useful reference photos.

A dataset of national or regional conversion factors for all allowable combinations will be the main analysis component of the library. The listed conversion factors should be provided at the lowest feasible (and representative) level of regional disaggregation. The general procedure for collecting weight measurements involves (1) finding vendors who have the necessary non-standard item-unit combination, (2) properly weighing the item-unit, and (3) recording the weight of the item-unit.

#### **Step 1: Finding item-units to weigh**

Armed with the list of item-unit combinations to weigh, enumerators should seek out each of the combinations from vendors in the market. Each item-unit measurement should be taken from multiple vendors to account for any variation in vendors’ subjective assessment of what constitutes a unit amount as well as for possible enumerator error in the measurement itself. For each item-unit pair we recommend collecting measurements from three different vendors within each market if time, personnel, and budget constraints permit.

Survey teams need not limit measurements to the predetermined list of item-units. If additional item-unit pairs are found at the market, record these as well. This will be particularly beneficial when the market survey is conducted before the main survey as it will allow the new units to be incorporated into the main survey.

If an item is available in the market, every effort should be made to collect all the listed unit options for that item. The greatest challenge at this stage will likely be that some items or units are not found due to seasonal availability of the item or limited use of a unit for sales. One solution is to search for the item-unit at vendors nearby who are outside the formal market. If the item-unit is found there, the alternative location should be noted by the enumerator.

The day of the market visit could also be an important determinant of NSU availability. In many communities, there are specific days designated as “market days.” On market days, a wide array of traders and farmers will participate in the market and thus, a greater selection of items and units will likely be available. However, there will also be more

activity on these days, making it harder to perform the measurements. Vendors may also be less willing to participate in the survey on a market day since they will be busier. Given this trade-off, we recommend survey teams visit the market first on a non-market day to acquire all the measurements available, and then again on a market day if any items or units are missing.

Since the focus of the survey is on consumption or production units and not specifically on market units, some container-based units may not be found at the markets. This could especially be the case for some agricultural production units used by farmers but not typically sold by vendors. Enumerators can ask vendors about the units in which they themselves purchase items from farmers, asking them to demonstrate the appropriate quantity of the item-unit pair. Alternately, survey teams may be able to acquire such containers directly from the source, (i.e., nearby households or farms). Containers may be purchased or borrowed and then brought to the market for filling and weighing.

Larger units, especially those used for measuring harvest quantities, may not be available from market vendors, but can be collected at the market scale station (further details below) or from wholesale traders in the market.

Locating a crop at the market in its various conditions will likely be difficult. Many crops will only be available in their final condition before consumption: cereals will likely be threshed; legumes will likely be shelled. In such cases, additional weights may need to be acquired by conducting some measurements at the farm-household level. A limited number of condition-specific weights can be used to create conversion factors across item-unit-condition pairs.

### **Step 2: Weighing the item-units**

Once an item-unit is located, it must be properly weighed. When weighing a container unit, the empty container's weight must be excluded from the measurement. Many modern scales can automatically subtract the weight of a container (the "tare" weight) from the total weight. If the scale being used does not include the option to zero out the tare weight, then the subtraction must be done manually.

Enumerators must be properly trained in the use of scales, including how to identify appropriate (even) surfaces on which to use the scales. Scales should be calibrated regularly during fieldwork to ensure consistency across measurements. It is important that the scale be kept clear of any other objects, including any spillage from containers. For example, any grains

that fall out of a heaped container and onto the scale should be cleared before weighing.

Enumerators should not be responsible for determining the amount of the item with which a particular unit is filled. They should only weigh what vendors provide. This includes typical heaping practices for containers. If the local practice is to heap as much of an item into a container as possible, then that is what should be weighed; if leveling is common, then leveled containers should be measured. When container quantities are available heaped and level, both should be measured and noted.

While most item-units will require physical weighing of the unit, in some cases no weighing will be required. This is true for item-units that are commonly purchased prepackaged, with the weight printed on the container. Some common examples are bags of rice, tinned or canned foods (e.g., tomato sauce), snack items, etc. Note that although these item-units need not be weighed, reference photos must still be taken since respondents may not remember the weight of the package but can identify which size/shape package they consumed.

For most consumption units, collecting the weights will be fairly straightforward. However, for larger units—especially those used for production—there may be additional challenges. Heavier item-unit pairs are often beyond the maximum range of the portable scales used for the survey. When this is the case, there are two potential solutions:

- Break up the unit into a series of smaller groups that can be weighed separately. Once all the groups have been weighed, they can be added together to acquire the total weight of the item-unit. Depending on the size of the item-unit and the maximum range of the scale used, this can be a laborious and time-consuming process. Furthermore, vendors may be unwilling to open larger units (if sealed) and have them handled by enumerators.
- Make use of other scales that have a higher maximum weight. These can be either additional scales that enumerators bring with them to the market or higher-capacity scales found in the market. In many markets, there will be bulk traders or aggregators that purchase items from farmers for resale to market vendors. Since these traders deal in large quantities, they will likely have a scale that can measure these heavier weights. Making use of these market scales may be easier than breaking up the item-unit into multiple groups, but it does require an additional

step: calibrating the market scale. In general, market scales may not be as advanced or accurate as the main scales used for the survey. Any error in the market scale measurement must be estimated and corrected. That can be done by selecting an item that weighs close to the maximum of the survey scale. This same item should then be weighed using the survey and the market scales and both measurements should be recorded. Comparing these two measurements will allow for error correction in the market scale's measurement during the data-review process. Only one calibration is needed for every market scale. Since it may be impossible or at least impolite to adjust or even scrutinize the market's scale, consider doing this after all unit measurements are collected. This procedure requires that the measurement tool also be noted: survey scales or a market scale. These scales will typically not be as precise as the smaller-capacity scales, but they are sufficiently precise for larger units. If higher-capacity market scales are not available or common in the market, then larger-capacity scales may be acquired for use by enumerators for larger units.

Another potential challenge for production units is the adjustment of weights by bulk traders or aggregators. In some cases, traders will purchase an item-unit from a farmer and adjust the weight before distributing it to market vendors. For example, a farmer may bring a sack with 115 kg of wheat, but after purchasing it, the trader might adjust the weight of the sack to an even 100 kg before selling it to market vendors. The purpose of the market survey is to acquire conversion factors for units *reported by farmers*, so every effort should be made to weigh the item-unit the farmer brings to the market (e.g., the 115-kg sack of wheat) before it is adjusted by the trader.

### **Step 3: Calculating the conversion factors**

Calculating conversion factors can be a complicated process. Results from the market survey should be cleaned and outliers scrutinized. If there are relatively few measurements for each item-unit, outliers can distort conversion factors substantially. If different sizes for a unit were allowed, the measurement data may require further processing. A problem may arise where classifications of a small, medium, and large versions of a unit could vary considerably. For example, the small size of a unit found in market X may be larger than the large version collected in market Y. These must be reconciled so that there is a standard classification of small, medium, and large within the relevant level of geographic aggregation (e.g., region, state). This can be done manually through review and

comparison of the reference photos and reassignment of size. However, this can be burdensome if there are many measurements. An alternative method is to classify measurements based on their position in the distribution of measurements for that particular item-unit pair. The most basic approach is to classify observations that fall below the 33<sup>rd</sup> percentile as small, between the 33<sup>rd</sup> and 66<sup>th</sup> percentile as medium, and above the 66<sup>th</sup> percentile as large. However, the number of sizes must be considered before applying this method. Some units may only be found in two relatively uniform sizes, in which case only small and large size should be assigned. If possible, a review of the photos is arguably a more comprehensive approach, or at least a verification step, to solving this problem.

For some items, the additional component of condition will also need to be taken into consideration when calculating conversion factors. In most of these cases, conversion factors should be applied not only for converting to kilogram amounts, but also to render the quantities comparable to each other. For example, maize/corn can be harvested on the cob (usually fresh) or without the cob in grain form (usually dry). The kilogram conversion reported for fresh, on the cob maize is not directly comparable with the kilogram results of dry maize grains. To compare all reported maize conditions with each other, the conversion between maize on the cob and maize dry kernels/grains is also needed.<sup>3</sup>

Once cleaned, the measurements must be aggregated to an appropriate level. The mean or median measurement for each container unit can be used. For non-containers, the conversion factor will be item specific and should correspond to the reference photo included in the library. If there is significant regional variation, then regional-level conversion factors should be given. Otherwise, national conversion factors are adequate. The conversion-factor database should be organized so that there is a single conversion factor for each item-unit at the appropriate geographic level, though there may be some item-units not found in a particular region. Therefore, we recommend that national-level conversion factors also be provided even if there is significant regional variation. Figure 6 presents a subset of the conversion-factor library for Nigeria. In the figure, conversion factors are provided for the six geopolitical zones as well as the national average.

<sup>3</sup> The appropriate adjustment factors for this exercise are not part of the original set of libraries found in Annex 11, but could be considered in future conversion libraries and methodological research.



Figure 6 — Excerpt from a Conversion Factor Library for Nigeria

NIGERIA GHS-PANEL WAVE 3												
CONVERSION FACTORS												
ITEM CODE	ITEM NAME	UNIT CODE	UNIT DESCRIPTION	UNIT SIZE	CONVERSION FACTOR (KG)							
					NATIONAL AVERAGE	BY ZONE						
						NORTH CENTRAL	NORTH EAST	NORTH WEST	SOUTH EAST	SOUTH SOUTH	SOUTH WEST	
<b>GRAINS AND FLOURS</b>												
10	GUINEA CORN/ SORGHUM	11	Paint rubber		3.612	3.758	3.612	3.612	3.768	3.832	2.828	
		12	Milk cup		0.161	0.205	0.125	0.163	0.180	0.161	0.159	
		13	Cigarette cup		0.205	0.205	0.205	0.205	0.215	0.198	0.205	
		14	Tin		14.738	15.510	14.738	14.738	13.965	14.738	14.738	
		20	Congo	Small	1.000	1.280	1.000	1.000	1.000	1.000	1.000	.720
		21	Congo	Large	1.978	1.978	1.978	1.978	1.978	1.978	1.978	1.978
		30	Mudu	Small	1.073	.978	1.103	1.145	1.073	1.060	1.073	1.073
		31	Mudu	Large	1.353	1.368	1.248	1.445	1.353	1.353	1.353	1.353
		40	Derica	Small	0.238	0.238	0.238	0.238	0.238	0.138	0.338	0.338
		41	Derica	Medium	0.639	0.639	0.612	0.639	0.639	0.639	0.639	0.745
		42	Derica	Large	1.587	1.587	1.587	1.587	1.813	1.587	1.361	1.361
		43	Derica	Very large	1.889	1.889	1.889	1.880	1.890	1.870	1.925	1.925
		51	Tiya	Medium	1.825	1.825	1.825	1.825	1.825	1.825	1.825	1.825
		52	Tiya	Large	2.650	2.650	2.650	2.650	2.650	2.650	2.650	2.650
		60	Kobiowu	Small	0.595	0.595	0.595	0.595	0.595	0.595	0.595	0.595
		61	Kobiowu	Medium	1.110	1.110	1.110	1.110	1.110	1.110	1.110	1.110
62	Kobiowu	Large	1.210	1.210	1.210	1.210	1.210	1.210	1.210	1.210		
11	MILLET	11	Paint rubber		3.765	3.672	3.765	3.765	3.767	3.805	3.840	
		12	Milk cup		0.153	0.153	0.145	0.165	0.150	0.153	0.155	
		13	Cigarette cup		0.210	0.210	0.210	0.210	0.215	0.205	0.210	
		14	Tin		15.060	15.685	15.060	15.060	14.435	15.060	15.060	
		20	Congo	Small	0.924	1.160	0.924	0.924	0.924	0.924	0.688	
		21	Congo	Large	1.437	1.437	1.437	1.437	1.437	1.437	1.437	
		30	Mudu	Small	0.988	0.893	1.058	1.135	0.988	0.988	0.988	
		31	Mudu	Large	1.260	1.260	1.210	1.323	1.260	1.170	1.260	
		40	Derica	Small	0.243	0.243	0.243	0.243	0.243	0.145	0.340	

Source: World Bank, LSMS Team.

### 3.4 COLLECTING REFERENCE PHOTOS

The second element that must be collected during the market survey is a set of non-standard unit reference photos. After the market survey, all photos should be compiled and included in the library. This index should contain photos of all allowable item-unit combinations, with each one directly linked to the measurements used in the conversion-factor list. For example, the pieces of yam in a photo should be exactly the same pieces used to calculate the conversion

factors as described above, and something in the naming scheme of the photos should make this connection clear. This index of photos will be used to prepare the photo reference album.

### WHICH ITEM-UNITS REQUIRE PHOTOS?

Ideally, each item-unit included in the survey (including pre-packed foods) will have a reference photo. Practically, surveys

may wish to limit the photo book to items that represent a significant portion of the total food consumed or total food expenditures. It is essential that separate item-unit photos be taken for each non-container unit such as pieces or heaps. However, for container units (pails, plates, etc.), a single photo for each container may be sufficient since the volume of the container does not vary with the item it holds. Item-specific photos of containers are useful if the fill level (heaped/level) varies significantly across each item. If units are expected to differ by region (e.g., only the North uses baskets, or the object called a pail in the West is different from the pail used in the East) then different photos must be taken in each region as well. However, for units that are relatively uniform across the survey area, only one photo need be taken.

### GUIDELINES FOR REFERENCE PHOTOS

The primary purpose of these photos is to compile a reference album for use during household survey data collection. With this tool, respondents can estimate quantities in relation to the related reference size. For example, when shown a reference photo of a potato during the household survey, a respondent can say she ate three potatoes of the size shown, or consumed one potato that was about half the size of the reference potato. Additionally, the photos serve an internal purpose in the creation of the conversion factors, as they can be used for verification/validation of weight measurements collected by the market team. The photo quality, while important for both applications, is far more critical for

the reference album that will be shared with respondents. When enumerators are instructed to take photos of all measurements, the research team will have multiple pictures to choose from when compiling the photo reference guide.

For the reference photos to be useful, they must depict the referenced quantities in a way that can be easily understood and interpreted by survey respondents. Regardless of the enumerators' general familiarity with taking photos, ample time should be allotted for training enumerators on the photo requirements for this exercise. Effective and easily interpreted reference photos should adhere to these guidelines:

- Photos should be well lit so that respondents can easily see the items and differentiate between the item and its shadow or background.
- When possible, a plain background should be used for each photo. This could be a piece of paper, a sheet, or some other material. The plain background will serve to better highlight the item, especially when its color contrasts with the item color.
- Each photo should contain only one food item or one food unit. For example, a photo of shelled groundnuts should not include unshelled groundnuts or maize; a picture of pails (a unit used for various items) should not include bunches or piles of a particular food.
- For units that come in various sizes (e.g., small, medium, large), all sizes of the item-unit must be present in the

Figure 7 — Correctly Photographed *Sahins* of Rapeseed



Source: World Bank, LSMS Team.

Figure 8 — Correctly Photographed *Tasas* of Sunflower Seeds



Source: World Bank, LSMS Team.

same photo to help respondents differentiate between sizes. The items should always be in the same size order (i.e., left to right, ordered from small to large) in the picture. However, some units may be too large to include the size variations in a single photo. For such units, special care must be taken to ensure that the photos of the different sizes are directly comparable – this means that they are taken from the same angle and same distance

and include the exact same reference item (positioned the same way relative to each item-unit).

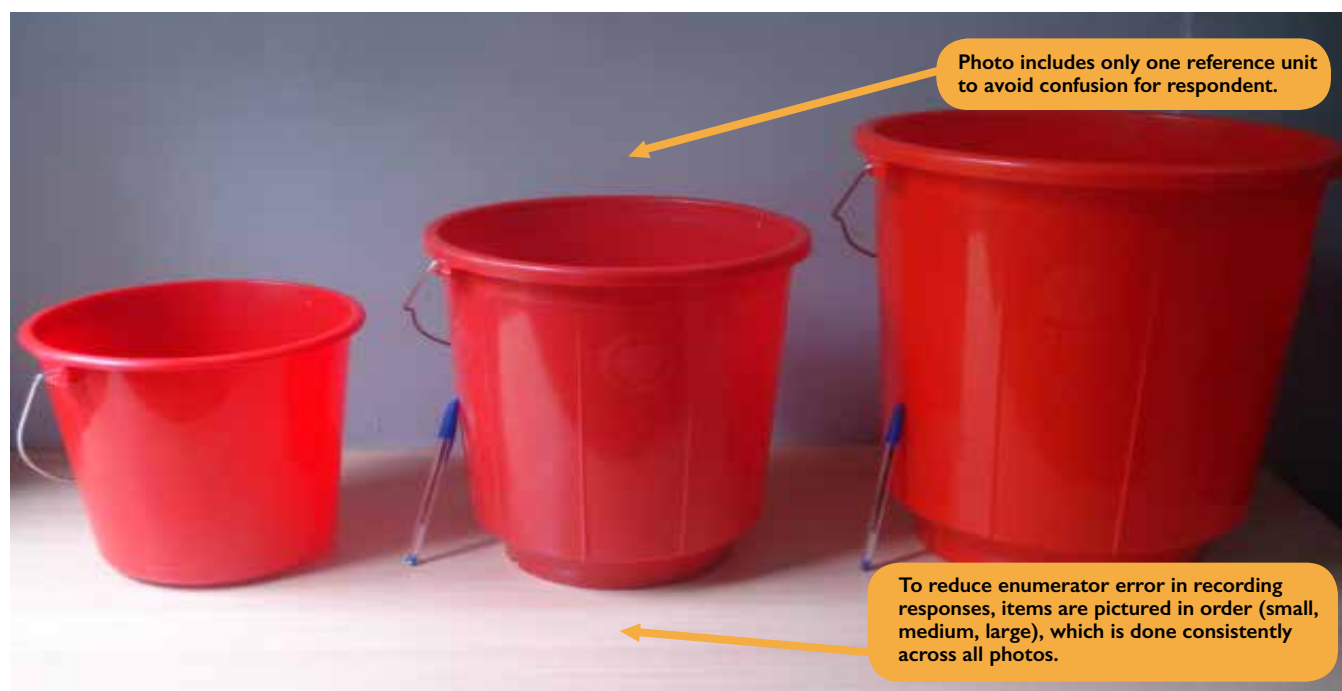
- A size reference item must be included in the picture to illustrate the relative size of the main objects. The item should be something that generally comes in one standard size, is easily identifiable to respondents, and could be brought to interviews by enumerators. Exam-

Figure 9 — Correctly Photographed Heaps (*Medebs*) of Papaya



Source: World Bank, LSMS Team.

Figure 10 — Correctly Photographed Empty Pails (to be used as unit reference for multiple items)



Source: World Bank, LSMS Team.

ples include a water or soda bottle, a writing pen, a box of matches, etc. This is a critical component of the photo. Without it, respondents may not be able to accurately judge the size of the item-unit in the photo.

- The dimension or volume of the item-unit must be clear. Usually this means taking the picture from a side angle, either directly horizontal to the item, or slightly above horizontal. For some non-container units such as pieces, aerial photos (taken from directly above) may be acceptable or sometimes preferred. The key is to ensure that the volume of the item is conveyed in the photo.

Several example photos are shown in this section. Figures 7 through 10 (above) are examples of photos that follow these guidelines. Each photo has a reference object (a soda bottle in this case), a plain background, sizes shown in the appropriate order, and all taken from an angle that allows respondents to accurately gauge the size/volume of the unit.

Figures 11 through 14 are examples of photos that were not taken correctly and will be difficult for respondents to interpret. Figure 11 shows a direct overhead view, whereby the volume of the container cannot be accurately gauged. The photo could be of a shallow plate or a very deep

bucket, but it is impossible to tell from the photo. The item is also not photographed in its original container, which makes it more difficult to understand the volume.

Figure 12 features three different sizes, but the direct overhead angle may be misleading for piles of vegetables. Does the large pile have only the five pieces shown, or are there more stacked underneath? How many pieces are really in the medium pile? There is also no reference item, so it is impossible to tell if the small items are the size of golf balls or tennis balls. Finally, the items are in reverse order (large to small); assuming the other photos and the questionnaire list/label units from small to large (as is most commonly done), then photos that do not follow this pattern will increase the likelihood of enumerators incorrectly recording (transposing) the unit size of the item shown during data collection.

In Figure 13, all three sizes are included, as is a reference item. However, the background adds a lot of unnecessary distraction. And the inclusion of onions in the photo may confuse respondents.

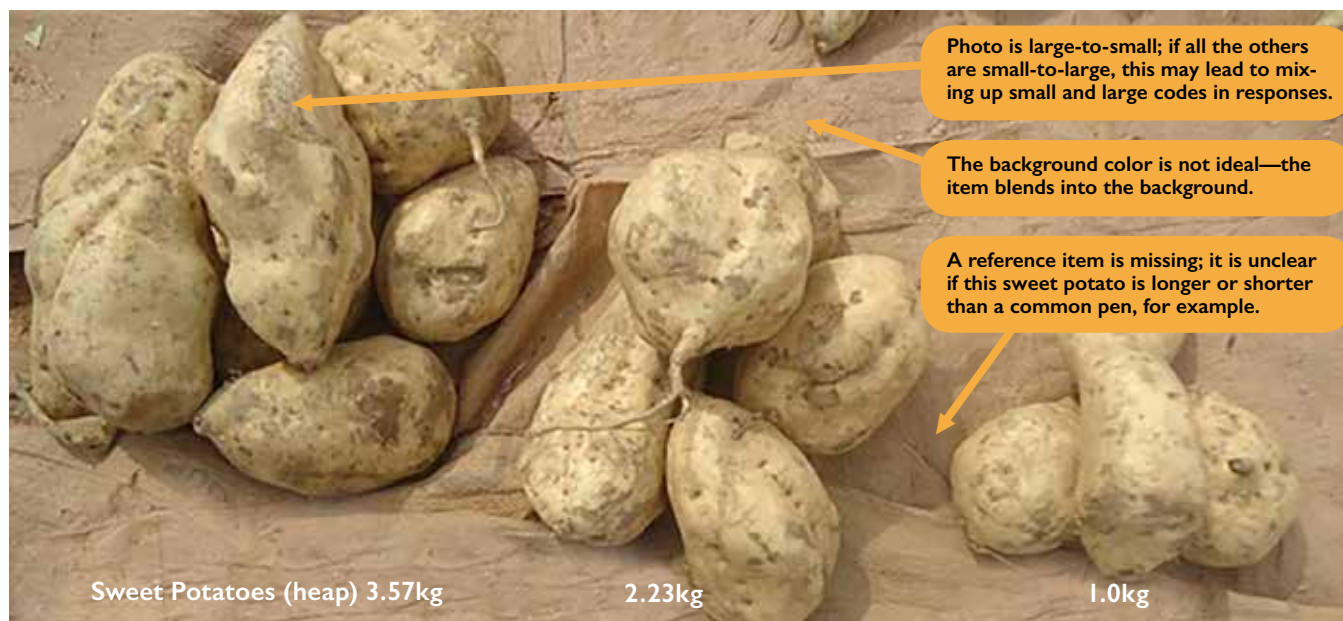
In Figure 14, the items are also in reverse order. More problematic, though, is that the small basket (on the right) was photographed separately using different backgrounds, angles, and

Figure 11 — Incorrectly Photographed Mudu of Gari



Source: World Bank, LSMS Team.

Figure 12 — Incorrectly Photographed Heaps of Sweet Potato



Source: World Bank, LSMS Team.

Figure 13 — Incorrectly Photographed Heaps of Green Peppers



Source: World Bank, LSMS Team.

Figure 14 — Incorrectly Photographed Baskets



Source: World Bank, LSMS Team.

distances from the camera for both the basket itself, as well as for the basket in relation to the reference item. All these details make the small basket in the photo visually similar (or greater) in appearance than the medium basket. This is not a useful reference for a respondent and will compromise the accuracy of the data reported.

To comply with the guidelines discussed above, survey teams will often need to have access to a large staging area in which to take photos, especially for larger units or when more than one size of a unit is photographed at once. In compact or crowded markets, this can be a significant challenge. Enumerators may not have enough space to position the camera sufficiently far away to capture all elements in the photo. Similarly, enumerators may block passages in the market when taking the photos. This can cause disruption in the market and create animosity from vendors or market patrons. If the market is crowded or very compact, enumerators should try to find a staging area where they can take photos without much difficulty or disturbance. They should then attempt to collect as many measurements from vendors near the photo staging area.

## CREATING AND USING THE PHOTO REFERENCE ALBUM

Photos collected from the market survey should be scrutinized. The best photo should be selected for each item-unit combination for inclusion in the bank of reference photos. This reference tool will be used to establish a clear connection between the respondent's reporting and the established conversion-factor database. If the size of the reference album must be limited, focus on the most commonly reported NSUs. Reference aides should be printed in color, using a durable material that will withstand fieldwork (such as cardstock, or laminated paper), or should be shown on tablets if the survey is conducted using computer-assisted personal interview (CAPI) technology. The list of reference photos should be organized to match the survey sequence and thus facilitate its use in the field. Forcing enumerators to flip through a multitude of pages of photos to find a particular item or unit will waste time and result in frustration on the part of both the enumerator and the respondent. Both CAPI and paper-based surveys can benefit from printed photo reference albums, which can sometimes be more easily shared with respondents during an interview.

When administering the consumption or agricultural production questionnaire, the enumerator should allow the respondent to report quantities in the unit with which the respondent is most familiar. The enumerator should not provide the respondent with

the list of allowable item-unit combinations, but should instead refer to the list to ensure that the item-unit provided by the respondent is indeed valid. If the unit the respondent gives is not listed, then the enumerator should use his or her judgement regarding its validity. After the respondent has specified the quantity in the preferred unit, the enumerator should check to see if there is a reference photo for the item-unit. If there is, the enumerator should show the photo to the respondent and verify that the pictured unit is similar to that referred to by the respondent. If applicable, the enumerator should also ask which size of the unit most closely matches. The respondent may need to re-estimate his or her consumption/production in terms of the reference photo.

## 3.5 HOW TO USE THE NON-STANDARD UNITS LIBRARIES

Once all the necessary components are assembled into the NSU library, protocols should be drafted to provide guidance to both enumerators and data users on how use the library. Clear protocols for using NSUs and reference photos must be provided to field teams for the primary household and agriculture surveys. Likewise, clear protocols for using the conversion factors must be provided to data users. Each NSU library should include clear, coherent, and concise documentation so that the libraries can easily be used by researchers and field teams. Incorporation of NSU materials into household and agriculture surveys will require additional preparation, which can be done by the household survey team or as a final step in completing part of the NSU library documentation, in which case each household survey team will need to evaluate the available materials in order to adapt them to its needs. This preparation includes revising the consumption (and when applicable, harvest) questionnaire sections to include NSUs and crop conditions; preparing the photo reference guides to be used by teams; and providing instructions to enumerators on how to effectively incorporate these new resources. Annex I contains examples of documents used to incorporate NSUs into the Ethiopian Socioeconomic Survey: the food consumption section of the household survey, including a code sheet for reporting NSUs; a photo reference guide to be printed, bound, and used by enumerators during their interviews; and a sample section of an enumerator training manual that provides instruction to enumerators on the use of the questionnaire and the photo reference guide. A snapshot of the Ethiopia consumption questionnaire that incorporates NSUs is shown in Figure 15.

The LSMS team has created conversion-factor libraries for Nigeria, Ethiopia, Malawi, and Uganda, with more planned for Tanzania, Niger, Mali, and Burkina Faso. They are provided

online in Annex II as they were used to support LSMS data-collection efforts in each country. The process of compiling these libraries has made it possible to further refine the guidelines and best practices outlined herein.

Although some of these libraries may not have the complete set of recommended items or may have some photos that do not meet all the stated recommendations, they can still serve as valuable resources. Both partial and completed libraries can be used by researchers and fieldwork teams to help increase the accuracy of reported quantities in their own work, without incurring the significant time-cost burden required to establish a new set of conversion factors. Even so, the libraries should be considered living documents, to be revised and updated with each new data-collection effort. Available foods and commonly used units and quantities may vary over time, so even complete libraries should be reviewed and piloted prior to their use on a new project.

Researchers conducting their own fieldwork can begin by including the existing lists of allowable item-unit pairs into consumption and production questionnaires, training enumerators on the proper use of photo reference aides, and incorporating the provided data-set of NSU conversion factors into interview and data entry checks. When possible, research teams should do a brief pilot test of the commonly-available NSUs in their survey area, as these may change over time or vary across regions; conversion-factor data and photos would only need to be collected for any newly available combinations. For research projects focused on analysis of existing data, where that data allowed for NSU reporting but conversion factors may not be available, the LSMS libraries can help increase the number of usable observations. Annex II provides additional information and user instructions on each of the available libraries.

Figure 15 — Excerpt of a Household Survey Allowing for NSU Reporting

SECTION 5A: FOOD LAST 7 DAYS						
F O O D  I D	1.		2.		3.	
	Over the past one week (7 days), did you or others in your household consume any [ITEM]?		How much in total did your household consume in the past week?		How much came from purchases?	
	INCLUDE FOOD BOTH EATEN COMMUNALLY IN THE HOUSEHOLD AND THAT EATEN SEPERATELY BY INDIVIDUAL HOUSEHOLD MEMBERS  YES...1 NO...2 ► NEXT ITEM		SEE UNIT CODES ABOVE		IF NONE RECORD 0  SEE UNIT CODES ABOVE	
CEREALS						
	1		QUAN-TITY	UNIT CODE	QUAN-TITY	UNIT CODE
	Teff					
	Wheat					
	Barley					
	Maize					
	Sorghum					

CONSUMPTION UNITS		
UNIT	SIZE	UNIT CODE
Kilogram		1
Gram		2
Litres		4
Centilitres		5
Jog		8
Melekiya		9
Birchiko	Small	31
Birchiko	Medium	32
Birchiko	Large	33
Esir	Small	61
Esir	Medium	62
Esir	Large	63
Festal	Small	71
Festal	Medium	72
Festal	Large	73

Source: World Bank, LSMS Team.



# 4. Benefits of Using Computer-Assisted Personal Interviewing (CAPI)

*Materials collected to support the use of NSUs can be used with both paper-based and computer-based surveys. However, some aspects of the information collected for use with NSUs can be greatly enhanced when used with computer-assisted personal interviewing (CAPI). CAPI provides unique benefits when conducting a market survey, particularly with respect to the ability to directly link weight measurements with reference photos. When conducting the main food consumption or agricultural production survey, CAPI can make better use of collected reference photos as well as conversion factors (to identify outliers). Both these aspects are discussed in turn here.*

## 4.1 CAPI FOR MARKET SURVEYS

Market surveys are ideal candidates for collection using computer-assisted personal interview (CAPI) technology. Perhaps the strongest advantage that CAPI collection has over paper is that photos can be directly linked to measurements. When conducting a market survey using paper, one must ensure that the photos can be linked to the correct weight measurement observation. One way to ensure this link is to apply a rigorous naming scheme for the photos, referencing the item-unit, the market in which it was taken, and the measurement observation it refers to (if there are multiple measurements within the same market). Renaming these photos while conducting the survey can be time consuming for enumerators and can lead to mistakes. However, when using CAPI software (such as Survey Solutions), photos can be taken immediately after recording the measurement and can be directly linked to that measurement observation. The photo is automatically named with a reference to that specific case. In addition, CAPI software can provide a prompt to enumerators to take a photo of the measured item. This can help ensure that there is at least one photo taken for every item-unit measurement collected.

In addition, CAPI technology also makes the collection of additional metadata much easier. For example, GPS

coordinates where each specific measurement is taken (or at least the more general market location) can be automatically captured by the CAPI device. Likewise, the date and time the measurement was taken can also be automatically recorded.

Collection using CAPI also allows for on-the-fly consistency checks. Since relatively few measurements will be taken within a market, it is important to limit the potential for error when collecting weights in standard units. For example, the current measurement can be compared with previous measurements and flagged if it is significantly different. Likewise, a predetermined reasonable range for a particular item-unit can be applied. These bounds must be made flexible and must only account for the most egregious mismeasurements. For example, for very small units, any measurement over X kg would be unreasonable. These kinds of checks can identify some common errors such as reporting weights in grams instead of kilograms.

However, there is at least one potential drawback to using CAPI to conduct a market survey. In some cases, it could be more difficult to move between item-units within the listing on a CAPI survey. While conducting a market survey, the enumerators will not go item-unit by item-unit. Instead, they will move within the market collecting what item-units they see, not necessarily in order. For the CAPI program to be

usable in the market setting, enumerators must be able to move easily between item-units in the list. Survey Solutions CAPI allows for such flexibility; evaluation of other software options should take this into consideration.

## 4.2 CAPI FOR FOOD CONSUMPTION AND AGRICULTURAL PRODUCTION SURVEYS

All the reference library resources detailed above can be used with both paper-based and computer-assisted personal interviews (CAPI). Several CAPI-based programs have capabilities that allow photo references to be incorporated into the interview, so that an enumerator can share relevant images with the respondent as an item is being discussed. In several cases, programs connect the photo directly to the item-unit combination represented, so that “selecting” the photo automatically defines the conversion factor for the item reported.

The importance of collecting data on allowable item-unit combinations and calculating their conversion factors prior to the start of fieldwork is made even more critical with CAPI. When used with CAPI, these tools can create more dynamic *in situ* validation checks for enumerator use. Allowable combinations can be programmed into CAPI, so that only these options can be selected for any given item. The full set of such combinations is usually far more than an enumerator can be expected to recall during an interview, so

building them into the parameters of the survey reduces the number of invalid observations reported during data collection. By applying conversion factors to data as they are being collected, reporting errors can be flagged and reviewed with respondents at the time of the interview, further reducing the number of invalid observations and eliminating the need for costly follow-up visits. CAPI programs can include checks of each item, including confirmation that price per kilogram and/or total and per capita standard-unit quantities are within reason. Some CAPI programs can also generate checks and reports compiled across multiple items entered, creating a summary list of all crop harvests in kilograms, listed in order of quantities, that enumerators can review with households for on-the-spot validations, ensuring that top-reported crops match farmer’s expectations, for example. When collecting data on household consumption, caloric values can be included to generate food-consumption summaries; enumerators can review these immediately with household members, checking, for example, that the average caloric intake of household members is within reason, and that the ranking of foodstuffs by caloric share of diet makes sense.

As with any survey using CAPI, it is worth emphasizing the importance of dedicating sufficient additional time and resources to ensure the CAPI program is well programmed and that all checks and validations are incorporated before fieldwork—and even before training and piloting—begins. This additional up-front time will ensure that interviews run more smoothly, save time, and produce less data errors.

# 5. Conclusion

*Food consumption and agricultural production are two of the most important and commonly measured quantities for welfare analysis in low- and middle-income countries. Both are critical inputs into poverty estimates for these countries and agricultural production is essential for estimating farmer productivity. Many strides have been made in improving several aspects of these estimates, but until recently the challenge of converting non-standard (NSUs) has received less attention.*

The usual practice has been either to limit households to reporting in standard units or to have enumerators estimate the conversion to a standard unit on an ad-hoc basis, both of which can be very problematic and lead to poor estimates. The use of NSUs can increase the accuracy of reported quantities in food-consumption and agricultural-production surveys. Reliably documented conversion factors for NSUs ensure that data robustness is not reduced by the loss of valid observations.

The objective of this Guidebook has been to provide advice to survey practitioners on incorporating non-standard units into their surveys, along with practical guidance

on how to create a complete NSU library resource for countries where one does not currently exist. In addition, the Annexes to this Guidebook include sample questionnaire instruments as well as resource libraries from the LSMS-ISA project (Nigeria, Ethiopia, Malawi, and Uganda). The libraries can be of use when working on any surveys or with any survey data in the selected countries. The Annexes include the allowable item- (and condition-) unit combinations for each of the countries and all photo references collected. The Stata files containing the conversion factors are available at [www.worldbank.org/lsms](http://www.worldbank.org/lsms) under Publications/Guidebooks.

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# ANNEX I

## SURVEY INSTRUMENTS

NSU MARKET SURVEY: QUESTIONNAIRE (NIGERIA)

NSU MARKET SURVEY: MANUAL (NIGERIA)

HOUSEHOLD SURVEY: REFERENCE PHOTO ALBUM (ETHIOPIA)

HOUSEHOLD SURVEY: CONSUMPTION MODULE (WITH NSUs)

HOUSEHOLD SURVEY: TRAINING MANUAL (EXCERPT)

\* Additional examples available online

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