



50x2030

DATA-SMART AGRICULTURE

TECHNICAL NOTE ON NON-STANDARD UNITS

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50x2030 TECHNICAL NOTES FOR COUNTRY TEAMS

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This document is a product of the 50x2030 Initiative to Close the Agricultural Data Gap and was developed by Josefine Durazo (World Bank), with comments from Gbemisola Oseni (World Bank) and Kevin McGee (World Bank) as well as members of the 50x2030 Methods & Tools coordination team. This document draws heavily from the LSMS guidebook, “The Use of Non-Standard Units for the Collection of Food Quantity” (Oseni et al., 2017).

The 50x2030 Initiative to Close the Agricultural Data Gap is a multi-agency effort aimed at supporting 50 low- and lower-middle-income countries to produce fundamental agricultural and rural data through the use of integrated agricultural and rural surveys. For more on the Initiative, please visit <https://www.50x2030.org/>.

This publication is part of a series of 50x2030 Technical Notes for Country Teams that will provide digestible, implementation-focused guidance for data producers and survey practitioners. Each note offers a brief summary of the motivation for specific survey design decisions followed by detailed, practical guidance that can be directly translated into survey design or training efforts. These notes are part of the existing 50x2030 Technical Note series.

1. INTRODUCTION & BACKGROUND

This reference note provides guidance to survey practitioners using non-standard units (NSUs) of measurement for the collection of production (harvest) quantities in 50x2030 surveys and beyond.¹ Allowing respondents to report in non-standard units (basket, sack, etc.) with which they are most familiar can improve the accuracy of harvest data which in turn contributes to more effective policy design. Establishing standardized conversion factors for all NSU quantities further ensures data reliability and allows for aggregation and comparison of harvest data.

Food production data at the farm/household level is very often collected as respondent-reported quantities via a recall interview. Respondents can report these quantities in either standard (e.g., metric) or non-standard units. This note addresses the methodologies of allowing respondent-reported quantities in non-standard units (NSUs) and the aid of two-dimensional food models (aka reference photos). Also reflected herein is the importance of recording and accounting for crop *condition* in order to properly convert, compare, and analyze reported quantities. Condition can have a large impact on harvest quantities (Fermont & Benson, 2011; Diskin, 1999; Murphy et al., 1991) with weight differences resulting from changes to the moisture content (drying) and/or discarding a portion of the crop via threshing, shelling, or peeling. This is particularly relevant for cereals and legumes, which are quite often processed before being used or sold.

IMPORTANCE OF NONSTANDARD UNITS IN HOUSEHOLD SURVEYS

In many household and farm surveys, respondents are required to estimate quantities in standard (metric) units, typically kilograms or liters. In many cases, this method requires respondents to convert from whatever unit actually used (e.g., baskets of beans, bunches of bananas) to a standard unit. Requiring respondents to report only in standard units, especially when they may be more familiar with NSUs for a particular item, involves multiple steps of cognitive and memory recall that could impose a greater cognitive burden on the respondent, therefore creating greater opportunity for measurement errors. Easing the burden on the respondent will require additional preparation on the part of the survey/research team to ensure that NSU quantities can be converted into standard units for aggregation and analysis.

In low- and middle-income countries, especially in Africa, NSUs are used quite regularly for many important crops. At markets in these countries, consumers encounter a wide variety of NSUs for their purchases. When given the option to report quantities in standard and non-standard units, respondents often choose to report in NSUs. For example, when the option of NSU reporting was introduced in the second wave of the Ethiopia Socioeconomic Survey (2013/2014) nearly 50 percent of farmers chose to report their harvests in NSUs. In the Malawi Integrated Household 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.

2. PRACTICAL GUIDANCE FOR CAPTURING AND USING NON-STANDARD UNITS

To effectively use data reported in NSUs, a set of resources must be prepared. Though existing data must first be taken into consideration, establishing a baseline of properly documented NSUs will most often require conducting a targeted market survey, whereby field teams seek out item-unit-condition combinations in markets (and possibly some households) to weigh and photograph. Market survey outputs become the inputs used to allow NSU reporting in the main household survey: the reference photos are shown to respondents during interviews and the weights are used to create conversion factors (CFs) that are applied to the reported NSU quantities, facilitating their use in data quality assurance and

¹ For more on 50x2030 see www.50x2030.org

data analysis. Collectively, these components comprise what is referred to herein as the NSU library. A complete NSU library consists of:

- A list of valid item-unit combinations commonly used in the country/region of the survey (rice-pail, banana-bunch, banana-stalk, etc.), including condition and size options as appropriate (small basket of shelled peanuts, large pail of dried rice, etc.). See section 2.1.
- National and, if needed, regional standard-unit conversion factors for all NSU combinations. See section 2.3.
- A photo reference guide of the most common NSUs is strongly recommended, as it can help standardize respondents' NSU reporting. See section 2.3.
- Clear protocols and training materials for household survey teams to properly use reference photos during data collection. See Annex I for samples.
- Clear and concise documentation on how conversion factors were collected and user protocols for data users.

Taken together, these components will help researchers adopt the use of NSU reporting. Proper NSU use entails the following steps (see Figure 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;
- Market survey implementation—Collect weights and reference photos, taking into account any sub-national variation;
- Create tools 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);
- Conduct the main survey, allowing for reporting of quantities in NSUs; and
- Finalize data documentation—Ensures data users can accurately process and analyze reported quantities and may encourage intra-survey NSU standards.

2.1 PLANNING AND PREPARATION

The best practice for using NSUs with reliable conversion factors would be for NSOs to establish a conversion factor library independent of any specific household survey, which could be made available for any survey within the country. When such a resource is already available and well documented, it can be used to optimize timeline and budget constraints. When it does not exist – or if existing conversion-factor data are limited, outdated, or inadequately documented – the survey team will need to create the library of resources, which will require an NSU-focused market survey, possibly combined with a limited number of visits to farming households.

TIMING OF MARKET SURVEY

Seasonality. The data-collection schedule for the market survey should take into consideration the seasonal availability of 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. Market-survey data collection may need to be planned in two separate periods to ensure complete coverage of seasonally available items.

Survey sequencing. Performing the NSU market survey before the main household survey (*ex-ante* or independently) is recommended as it has several advantages. 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. *Ex-ante* market surveys also allow for the identification of additional/new NSUs that may have been missing from any existing NSU lists. Identified in advance, these units can be incorporated into the unit list for the main survey. New units not included in the NSU survey could still be reported in the main survey (under “other, specify”), though ideally this should occur infrequently. When the NSU survey is performed after the main survey (*ex-post*), the unit list can be constructed to include all item-unit-condition combinations observed in the main

survey, limiting any conversion-factor gaps. Ideally NSU market data would be collected in two phases: a detailed *ex-ante* NSU market survey to collect as many conversion-factor weights as possible, followed by a much smaller, focused *ex-post* market survey that would be limited to collecting only those unanticipated item-unit-condition combinations reported during the household/farm survey and which are missing conversion weights.²

Complementarity. Though price data (a) is not needed for NSU and conversion factor calculations and (b) often requires visiting more markets, the NSU market data can be collected together with price surveys. In such cases, it should be clear that price reporting should not be used to back out weights/quantities – actual weight measurements must be collected regardless.

SELECTION OF MARKETS TO VISIT

Three main factors to consider when selecting markets for this survey are: the degree of regional diversity of units and their respective weights; the relative timing of market surveys (as explained above); and the types of markets and other data collection points where harvested crops are available for sale. This is especially important when the market survey is done *ex-post* and when photo reference aids are not used (see more under Considerations for Reference Photos). Whether *ex-ante* or *ex-post*, more markets are needed when there is greater regional variation in items harvested and units used. To ensure adequate coverage of regional units and items, regions with the widest diversity of units should be included in the market survey, as well as any regions that have items or units not commonly found in other areas. Note that it may not be necessary to conduct NSU market surveys in every region/strata where the main household survey is conducted.

PREPARATION OF SURVEY MATERIALS

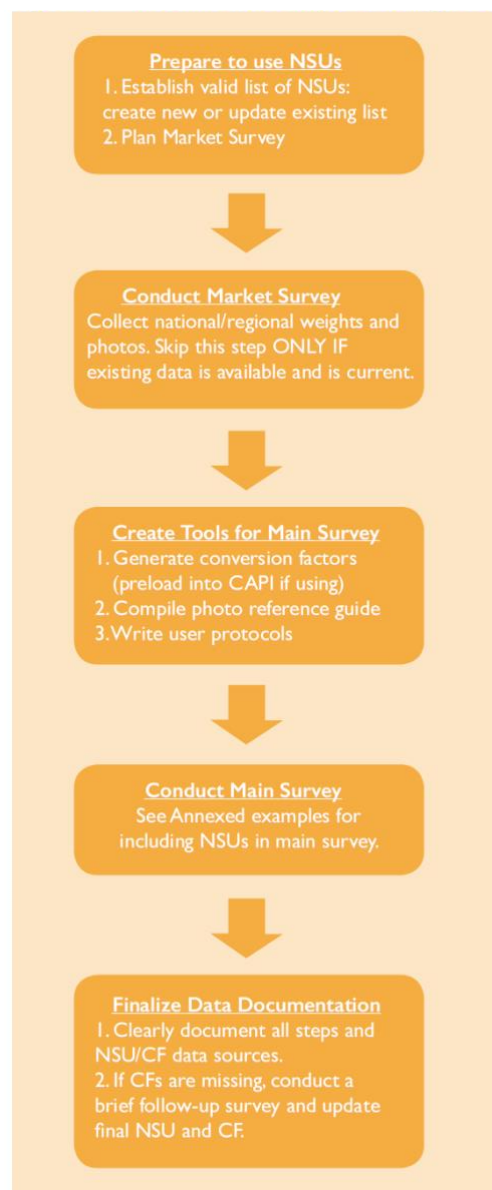
The questionnaire and supporting survey/training materials can be prepared even before specific markets are selected. While these materials should be designed according to the local context, Annex II includes an example questionnaire for an NSU-focused market survey.³ Each survey should collect the following types of data:

- Market identification details: Name, location, GPS information, type of market, etc.
- Survey management information: Date, time, duration of surveys; codes for enumerator, supervisors, and (when applicable) data-entry staff.

² Alternatively, the *ex-ante* survey could be limited, collecting reference photos and weights (for conversion-factor calculations) for only the most common NSUs, while the *ex-post* survey could comprehensively collect weights for all additional NSUs reported during the main survey. However, this also means that photo reference guides will not be available during the household interviews, which (as explained above) may increase the amount of data collection required to establish reliable conversion factors.

³ For examples and templates from additional countries, see the LSMS Guidebook [The Use of Non-Standard Units for the Collection of Food Quantity](#).

Figure 1. Recommended Steps for Using NSUs



Source: World Bank, LSMS Team.

- Calibration details: record calibration metadata for all of the scales used at each market.
- Data on pre-identified NSUs: Weights and basic metadata for common item-unit-condition combinations that have been previously identified. This list could be split into two sections, allowing enumerators to more easily divide and share the data-collection work during each market visit.
- Data on unexpected NSUs: The same type of data listed above for combinations that are not on the pre-defined list, but that are present in the market.

CONSTRUCTING THE LIST OF ITEM-UNIT COMBINATIONS TO BE WEIGHED

Establishing the list of NSUs that will be used in the crop production module of the main household/farm survey, which will thus inform the NSU market survey questionnaire design, is the first step in preparing the NSU library. As it will not make sense for all NSUs to be allowed for all items, the list of NSUs should be combined with the list of expected items to create a list of valid/allowable item-unit combinations. Where applicable, crop condition (e.g., corn in husk or not, peanuts shelled or unshelled, fresh vs. dried cassava) must also be considered for harvested quantities, as it significantly impacts the weight-volume ratio. Further, many NSUs (such as pieces, heaps, baskets, etc.) are available in a variety of sizes – small, medium, large, half, whole, and so on. In such cases, simply recording *basket* as the unit may not be sufficient for a reliable weight conversion of this NSU. When item-unit-condition combinations are subject to within-unit weight/size variation, the NSU list can further support reporting standardization by allowing for size specification. Weights, and reference photos as appropriate, for each size should be collected.

Though it may be impossible to predetermine all the possible combinations, the library should endeavor to include combinations that represent the vast majority of quantities reported (preferably higher than 90 percent of reported harvests). Note that when the same crops are grown in different countries, it cannot be assumed that the same NSUs will be used in both places, nor that similarly named NSUs, automatically have the same conversion factor.

The extent of regional variation in reported NSUs should be assessed to determine the geographic scope of the market survey list. This can be done by comparing common units across geographic regions. If similar units are used across most geographic areas, 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 lists at the regional level.

Constructing the list for ex-ante/independent NSU surveys. Begin with a comprehensive review of NSUs used within the country, including any previously conducted household, agricultural, or market surveys that allowed NSU reporting; NSU libraries from previous LSMS surveys; or any other available sources. Survey designers must consider the comprehensiveness of these sources – both with regard to the range of NSUs and their regional representativeness – and their reliability. If they are not clearly documented and comprehensive, plan to collect NSU data. If resources permit, begin with a small pilot survey. Even where there is available data, a small pilot survey can be conducted to validate and potentially update existing NSUs.

The pilot survey can be done at markets and/or households. Conducting even a limited market pilot survey allows for the collection of many item-unit(-condition) combinations in a single market, whereas it may take several households to collect the same measurements. However, a household-level pilot has the advantage of capturing harvest units and conditions used by farm households, which may sometimes differ from units used in market transactions. 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.

Constructing the list for ex-post NSU surveys. The NSU list can be constructed based on the item-unit(-condition) combinations reported during the main survey. This list will include exactly those weights necessary to make use of the household/farm data, ensuring there are no gaps in the eventual conversion-factor data. Remove any invalid combinations (ex: rice by the piece, flour by the bunch).

Ideally, every valid item-unit-condition reported should be included for weight collection in the market survey. However, if the list is very extensive and/or resources for conducting the market survey are limited, then the list can be shortened – taking into consideration that NSU observations that cannot be converted will be rendered unusable. In general, only very infrequently observed combinations should be dropped.

CONSIDERATIONS FOR REFERENCE PHOTOS

NSU use, coupled with reference photos, can provide greater comparability across reported NSUs by standardizing the non-standard reference across respondents. This is especially true for item-units that are available in multiple sizes. For example, if tomatoes are scarce in only one region, what is considered a “large tomato” there may be equivalent to a small one elsewhere; by providing photo references, the respondent can point to “their” tomato, thus ensuring its weight is converted in a standardized way, regardless of local variation. 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, allowing for greater standardization with fewer measurements. Ex-post surveys need to collect and compare more NSU data from markets in all regions to avoid under- or over-reporting across regions with different concepts of specific units or their reference sizes.

Which items and units require photos? Ideally, every valid combination (item-unit-condition-size) included in the survey would have a reference photo, including prepackaged items. Practically, this may result in a cumbersome interview experience and survey planners may wish to limit the photo book to items that are both most commonly reported in NSUs and also represent a significant portion of the total food consumed or total food expenditures. The next section provides details on conducting the market survey, including guidelines for collecting and using reference photos.

2.2 CONDUCTING THE NSU MARKET SURVEY

The two main purposes of the market survey are to collect weights to calculate conversion factors for NSUs and to take reference photos for use during household/farm interviews. Although the procedure for collecting weights and photos may seem straightforward, strict protocols are required to ensure the most accurate conversion factors and produce useful reference photos.

COLLECTING WEIGHTS FOR CONVERSION FACTORS

A dataset of national or regional conversion factors is critical for processing data reported with NSUs and is the main analysis component of the library. The general procedure for collecting weight measurements entails finding vendors who have the necessary non-standard item-unit-condition combinations, properly weighing them, and recording the weights and associated metadata.

Finding item-units to weigh. Every effort should be made to collect weights for all the listed NSU combinations available in each market. Measurements should be taken from multiple vendors at multiple markets. This will account for any variation in vendors’ subjective assessment of what constitutes a unit amount as well as possible enumerator error in the measurement itself. For each combination, aim to collect measurements from three different vendors within each market (time, personnel, and budget constraints permitting). Any additional combinations found at the market should also be recorded. With ex-ante surveys, these additional combinations are incorporated into the main survey questionnaire thus minimizing the extent of ex-post weights collection required. In ex-post surveys, this additional data collected at a marginal cost (teams are already at the market and weighing items) will benefit future surveys as part of the country’s NSU library.

The day of the market visit could be an important determinant of product availability. Many communities have specific days designated as “market days,” when a wider array of traders and farmers participate in the market and thus a greater selection of items and units will likely be available. However, markets are also busier on these days, making it harder to conduct the measurements. Vendors may also be less willing to participate on a market day since they will be busier with customers. Given this trade-off, survey teams should consider visiting the market first on a non-market day to acquire all the measurements available, then again on a market day if any combinations are missing.

For combinations not found at the market, search vendors outside but nearby the formal market. Alternative data collection locations should be reported by the enumerator in the questionnaire notes. The larger units used for measuring harvest quantities may not be available from individual market vendors, but could be available at the market scale station (further details below) or from wholesale traders in the market. Some crop production units may not be available at all in the markets, especially agricultural production units used by farmers but not typically used by vendors. Enumerators can ask vendors about the units in which they themselves purchase items from farmers, asking them to demonstrate the quantity of the NSU combination. Seasonal availability of items or limited use of a unit in a given region may result in some NSU combinations not being available at all. Survey design teams will need to plan how and when to obtain such measurements.

Alternately, survey teams may be able to measure some missing units or obtain missing containers units directly from nearby households or farms. Empty containers may be purchased or borrowed and then brought to the market for filling and weighing, or filled/weighed at farm household. Weights for some crops with multiple condition options may also need to be acquired at the farm-household level, as such crops might only be available at the market in their final pre-consumption condition (cereals threshed; legumes shelled, and so on). In such cases, conversion factors across all item-unit-condition combinations can be extrapolated from the weighing of just a few of the condition-specific combinations (see section 2.3). A limited number of condition-specific weights can be used to create conversion factors across item-unit-condition pairs.

Weighing and recording the combinations. Enumerators must be properly trained to collect accurate weight measurements. To ensure consistency across measurements, scales should be calibrated regularly during fieldwork and calibration details recorded as part of the fieldwork metadata. Training should emphasize the importance of, and provide visual examples for, only using the scales on appropriate (even) surfaces. Scales must be kept clear of other objects, including any spillage from containers. For example, grains that fall out of a heaped container and onto the scale should be cleared before weighing. When measuring items in container units, the empty container's weight must be excluded from the measurement. Most 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 amount must be subtracted manually.

Enumerators must not be responsible for determining the amount of the item with which a given container/unit is filled. They should only weigh what vendors provide. 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. Where container quantities are commonly available as both heaped and level, both should be measured and recorded.

Additional protocols should be established for collecting weights of larger production units, which may be heavier than the maximum range of the portable scales enumerators typically use. Potential solutions to consider include:

- *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 determine the total weight of the NSU combination. Depending on the maximum range of the scale used, this could be a laborious and time-consuming process for the largest of units. Furthermore, vendors may be unwilling to open larger units (if sealed) and let enumerators handle the items.
- *Make use of other scales that have a higher maximum weight.* In many markets, there are bulk traders or aggregators who purchase items from farmers for resale to market vendors. These traders typically have scales that can measure heavier weights. Though market scales may not have the same degree/decimal of precision as smaller-capacity scales, they are sufficiently precise for larger units. When using these scales they will also need to be calibrated to ensure any potential measurement error is documented and can be corrected for when preparing conversion factors. Only one calibration is needed for each market scale. Since it may be impossible or at least impolite to adjust or even scrutinize the market's scale, consider doing the calibration *after* all measurements are collected. Calibrate by selecting an item that weighs close to the maximum of the survey team scale. Weigh this using both the survey and the market

scales, recording both measurements in the questionnaire. If higher-capacity market scales are not available or common in the markets, survey management should evaluate whether larger-capacity scales should be acquired for shared use across enumerators and/or teams. During post-collection data processing, the calibration measurements from both scales will be used to correct for any discrepancies between the scales. This is why it is important to also record which measurement tool – enumerator scale, market scale, or high capacity team scale – is used to collect each combination on the NSU list.

Another potential challenge for crop production units is the adjustment of weights by bulk traders or aggregators. In some cases, traders will purchase a condition-unit amount of an item from a farmer and adjust the weight before distributing it to market vendors. For example, a farmer may sell wheat by the sack, where each sack weighs 115kg, 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 NSU combination the farmer brings to the market (e.g., the 115-kg sack of wheat) before it is adjusted by the trader.

CAPTURING PHOTOS FOR THE REFERENCE BOOK

The primary purpose of these photos is to compile a reference album for household/farm survey data collection. This allows respondents to report NSU quantities in relation to the quantities photographed, further standardizing NSUs reported by respondents. For the reference photos to be effective, they must depict the quantities in a way that can be easily understood and interpreted by the respondent. For them to contribute to accurate conversion factors, the photograph of an item must be connected in the data to the recorded weight of the same specimen (that is, the piece of yam in the photo should be exactly the same piece that are weighed and recorded in the questionnaire).

The market survey should capture several pictures of each combination so as to provide options to choose from when compiling the reference book. Each photo should capture only one unit, though multiple sizes of the same unit should be captured in the same photo (to facilitate visual comparison of the sizes). For container units (pails, plates, etc.), one photo can be used for all items, as the container itself does not vary with the item it holds. Item-specific photos of containers (ex: a pail of maize flour) are useful if the fill level (heaped or level) varies significantly across items.

Regardless of the enumerators' general familiarity with taking photos, ample time should be allotted for enumerator training (and practice) and review of the required photography protocols. Effective and easily interpreted reference photos should adhere to the following guidelines.

- Well-lit photos allow respondents to better differentiate between the item and its shadow or background.
- The photo background should be plain. When possible, enumerators should carry a 'backdrop' with them. This could be a piece of paper, a sheet, or some other material that is easy to carry. This will serve to better highlight the item, especially when it is a color that contrasts with the item.
- Each photo should contain only one food item. For example, a photo of shelled groundnuts should not also include maize in the picture; a picture of pails (a unit used for various items) should not include bunches or piles of a particular food.
- A reference item must be included to illustrate the relative size/scale of the main item. The reference item should be something that generally comes in one standard size, is easily identifiable to respondents, and could be brought to interviews by enumerators. Examples 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 photographed quantities.
- For combinations that come in multiple sizes, all sizes must be present in the same photo to help respondents differentiate between sizes. For all pictures, the sizes should always be in the same order (e.g., left to right, small to large). If the size variations are too many – or too varied – to make sense in a single photo, special care must be taken to ensure that the images are directly

comparable: photos taken from the same angle and same distance and including the exact same reference item (positioned at the same position/angle relative to each item-unit).

- The dimensions/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 three-dimensional volume of the item is conveyed in the two-dimensional photo.
- Annex III contains examples of photos taken correctly (see also Figure 2) as well as photos taken incorrectly, with notes on why. These can help with training, as examples of what to consider when taking market pictures for the reference book.

Figure 2. Correctly captured photo for Food Consumption Reference Book



Establishing a staging area in which to take photos, especially for larger units or when photographing units that come in multiple sizes, will help teams comply with these guidelines. In compact or crowded markets, there may not be enough space at stalls to position the camera sufficiently far away to capture all elements in the photo. Taking the photos at stalls may also block passageways in the market, causing disruption and creating animosity from vendors or patrons. If the market is crowded or very compact, enumerators should find a staging area where they can take photos without much difficulty or disturbance, then collect as many measurements from vendors near the staging area.

2.3 CREATING THE NSU LIBRARY OF RESOURCES

A completed NSU library can be a valuable resource for many surveys within the same country. When completed NSU libraries are widely available, they can help to avoid duplication of efforts and to encourage standardization of conversion factors across national surveys. Such libraries can also be used in the analysis of existing data (increasing the number of usable observations), where that data allowed for NSU reporting but conversion factors may not have been available or complete. Two critical components of this library are the conversion factor database and the photo reference guide.

CALCULATING CONVERSION FACTORS

A conversion factor is the multiplier used to convert a NSU combination into a standard unit of weight, such as grams. Every item-unit-size-condition will have a separate conversion factor. The two main options for establishing a given conversion factor using the NSU market survey data are:

- Calculate the mean or median of weights collected across all market surveys for a given item-unit(-condition)-size combination. This method is necessary for container units and for combinations that will not have a photo in the reference book.

- Assign the conversion factor to be the specific weight of the item-unit(-condition)-size combination of the picture selected for use in the photo reference book (more on this below). In such cases, calculating the average of weights collected across all survey is optional, as it could then be taken into account as part of the photo selection process.

Calculating conversion factors requires a meticulous review of the market survey data, including careful scrutiny of outliers. If there are relatively few measurements for each item-unit, outliers can distort conversion factors substantially. Additional data processing will be needed for combinations that have a size component if the size classifications vary considerably. For example, the small size of a unit found in market X may be larger than the large version recorded in market Y. This must be reconciled to establish a standard classification of sizes by order (small, medium, and large). Though this can be done manually through review and comparison of the reference photos and reassignment of specified sizes, it may become burdensome if there are many such measurements. An alternative method is to classify measurements based on their position in the distribution of measurements for that particular combination. The most basic approach is to classify observations that fall below the 33rd percentile as small, between the 33rd and 66th percentile as medium, and above the 66th percentile as large. However, the distribution of sizes must be considered as well. For example, some units may only be found in two relatively uniform sizes, in which case only small and large size should be assigned. When possible, a review of the photos is arguably a more comprehensive approach, or at least a verification step, to resolving this.

For items that have condition as a component, conversion factors should be established not only for converting to standard units (e.g. kilograms), but also to render all item quantities comparable to each other. For example, maize/corn can be harvested on the cob (usually fresh) with or without the husks; before sale (and possibly even before weighing it), farmers may further process corn by removing the kernels/grains from the cob – usually to then be dried. The weight of maize in these various conditions are not directly comparable harvest quantities nor consumption quantities (that is, the portion of the harvested food item that is suitable for consumption). To calculate and compare all reported maize, the conversion factors must be established to convert each of these various conditions into standard weight measurements. Surveys can report as harvest quantities or as edible/consumable quantities. This does not necessarily require measuring separate weights for *all* item-unit-size combinations of every condition. Measured weights of only a few combinations can provide enough data to extrapolate conversion factors for all condition combinations. Returning to the maize example, if both a pail and basket of fresh on-the-cob corn with husks weighs 10% more than fresh on-the-cob corn without husks, then the conversion factor of 10% between these two conditions (with husks and without husks) would be applied to all units. If the survey preference is to report edible/consumable quantities, then for each condition you would need to measure one unit of the item in its reported harvest condition, and then measure the portion of that amount that is edible; the ration between the two can then be applied to all units of that same item-condition type. Once all corn is converted into the same ‘condition equivalents’ it can then be converted into kilograms using the same NSU conversion factor.

National conversion factors are adequate, unless there is significant regional variation in units-sizes (especially for items that are not photographed). When regional-level conversion factors are calculated, national-level ones should still be calculated as well. The conversion-factor database should be organized so that there is a single conversion factor for each NSU combination at the appropriate geographic level.

CREATING THE PHOTO REFERENCE ALBUM

All photos from the market survey should be compiled and indexed in the reference library. Each photo should be clearly linked to its weight measurement, either through the naming scheme of the photos or a data crosswalk (metadata that documents which picture belongs to which measurement). This index of photos is used to prepare the photo reference album and also serves as internal purpose in the creation of the conversion factors, as they can be used for verification/validation of size classifications and weight measurements collected by the market team.

To create the reference album, the research team should carefully scrutinize the multiple photos of each NSU combination, selecting the best photo based on both composition and content. If any units differ

greatly 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 should be used in each region. However, for units that are relatively uniform across the survey area, one photo can be used throughout the country for the main household survey. Using this reference album will establish a clear connection between the respondent's NSU reporting and the conversion factor database. If the size of the reference album must be limited, focus on items most commonly reported in NSUs, as well as the NSUs used most frequently.

The reference photos should be printed in color. The pages, or at least the cover, should be a durable material that will withstand fieldwork (such as cardstock or laminated paper). Photos should be in the same order as the items are listed in the household questionnaire. Flipping back and forth between photos to find a particular item or unit will waste time and burden or frustrate both the enumerator and the respondent. CAPI surveys have the option of showing reference photos on the tablets. However, both CAPI and paper-based surveys can benefit from printed photo reference albums, as they can be more easily shared with respondents during an interview.

2.4 USING NSU TOOLS IN THE HOUSEHOLD SURVEY

Whether the household survey team prepared the NSU library or adopted an existing one, the methods for applying them to household survey work are similar. The household survey team will need to evaluate the available materials, adapting them to their specific survey needs.

Questionnaire revision. Revise the crop production (harvest) module to include the list of NSUs allowing for reporting quantities in NSUs, with sizes and crop conditions specifications as appropriate. Surveys that use CAPI can reduce potential interview and data entry errors by tailoring NSU selections for each crop item. Enabling only the NSUs, conditions, and sizes that are valid for each particular crop item reduces the frequency of invalid/unusable data points. To try to minimize these types of errors on paper questionnaires, enumerators will need to study and carry with them a reference table of the myriad of valid item-unit-condition-size options.

Preparing photo reference guides to be used during interviews. Decide whether photo reference books will be used and, if so, if interviewers will carry hard copy albums (recommended for both PAPI and CAPI) or reference a digital version on their tablets (possible with CAPI). Any field testing or piloting done for the household interview must also include use of the photo reference book.

Instruct enumerators on proper interviewing techniques for NSUs. When collecting harvest/production quantities, enumerators should allow the respondent to report in whatever unit with the respondent is most comfortable using. The enumerator should not list the allowable item-unit combinations for the respondent, but should refer to the list to ensure the unit provided by the respondent is valid. If the reported unit is not listed then the enumerator should evaluate its validity (recording reasonable responses as “other, specify”). The quantity should always be recorded in the units-conditions-sizes as reported by the respondent. This applies even when surveys choose to also ask respondents to estimate the kilogram weight of their quantities.

Train enumerators to effectively incorporate the photo reference book. Enumerators should first allow the respondent to report the crop quantity, using the unit of their preference, without any prompting or reference aids. Then, if there is a reference photo for the item-unit pairing, it should be shown to the respondent – verify that the pictured unit is similar to that referred to by the respondent, if applicable confirm which size best matches, and reconfirm and record the quantity as reported. To help respondents better understand the scale of the photos and the actual size of items pictured, each picture includes a size/scale reference item. Its purpose may not be intuitive and should be explained to the respondent.⁴

⁴ For example: When a respondent reports harvesting 5 papayas (pieces), the enumerator flips to the relevant photo to explain and ask, “Here are some papaya in different sizes. Notice their size compared to the pen, which is the same size as this pen [shows actual pen in their hand]; which size is most similar to the ones you harvested?”

Incorporate conversion factors into data checks and validations. Surveys implemented with CAPI can use conversion factors to create dynamic validation checks during the interviews. This allows potential reporting errors to be flagged for immediate reviewed with respondents at the time of the interview, reducing the number of invalid observations and the need for costly follow-up visits. Checks can be programmed to calculate each item's price per kilogram and/or total and per capita standard-unit quantities, flagging any that are not 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, to be reviewed with respondents on-the-spot, ensuring for example that top-reported crops match farmer's expectations. Regardless of the degree to which conversion factors are included in the data quality checks, a complete set of conversion factors are critical to any processing and analysis of the resulting household survey data.

ADDITIONAL RESOURCES (OPTIONAL)

The World Bank's 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 [available online](#) as they were used to support LSMS data-collection efforts in each country. These, as well as other completed libraries can be used by researchers and fieldwork teams to 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. For more detailed guidance on using NSU use in household surveys, including example documentation and training materials, see the LSMS guidebook, "*The Use of Non-Standard Units for the Collection of Food Quantity*" (Oseni et al., 2017).

ANNEXES

ANNEX I. REFERENCE PHOTOS IN HOUSEHOLD SURVEYS: PROTOCOLS FOR TRAINING MATERIALS

For the most effective use of reference photos in household surveys, enumerators will need to be trained on how to use this tool during the survey interview, including how to present and explain this tool to respondents.

The following text is a template for language to be included in the enumerator training manual:

When asking the respondent for the quantity of CROP harvested, always allow the respondent to report the QUANTITY in a UNIT of their choosing. If the crop is commonly collected and or processed in various conditions, ask them to indicate the CONDITION of the crop for which they are reporting quantities.

- If the UNIT reported is a standard unit (KG, G, L, or ML), record the QUANTITY, UNIT, and if applicable the CONDITION, as reported.
- If the UNIT reported is a non-standard unit represented in the reference album, **show the respondent the appropriate photo of the UNIT provided in the reference photo album.** Ask the respondent to confirm the SIZE of the UNIT (if applicable) and adjust the QUANTITY to best reflect the amount in relation to the pictured UNIT. *You should only question their response if the unit seems inappropriate for the crop.* For example, you would not expect to report the quantity of yam harvested/sold in milk cup; likewise, you would not expect the quantity of rice harvested to be reported in pieces. Be especially careful to always record the correct QUANTITY-UNIT combination.
- If the UNIT reported is a non-standard unit that is **not represented** in the reference album, record the QUANTITY, UNIT, and if applicable the SIZE and/or CONDITION, as reported.

The following skit demonstrates how the album should be presented and explained to respondents. Items, units, conditions, sizes, codes, and reference periods must be updated to match the specific survey before it is shared with interviewers.

For this example, the respondent has reported 'yes' to harvesting yams during the reference period.

INTERVIEWER: How much yam did you harvest during the [REFERENCE PERIOD]?

RESPONDENT: I harvested 6 pails of yams.

The INTERVIEWER opens the reference album to the photograph of PAILS, which come in 4 different sizes.

INTERVIEWER: Here is a photo of different size pails. Notice there is also a standard size bottle of water in the picture

[optional: which is the same size as the bottle of water I have here in my hand]. This is so that you can see the size

of the pails compared to the bottle, to help you better understand the real size of the pails. Which pail is most similar to the size of pails you harvested yams in?

The RESPONDENT indicates the extra-large pail.

Since farmers often dry yams before weighing/measuring and selling, the interviewer should confirm the condition.

INTERVIEWER: These 6 pails of yams – this was the amount when they were harvested, or did you dry or process them in any

way before measuring them?

RESPONDENT: This was the amount I harvested, before I dried it.

INTERVIEWER records the amount: QUANTITY=6, UNIT=pail (code 5), SIZE= extra-large (code d), CODITION= fresh (code 1).

ANNEX II. MARKET SURVEY FOR NSUs – SAMPLE QUESTIONNAIRE PAGE

This is a sample questionnaire format for the NSU market survey. The complete lists of items, conditions, and units to be included must be tailored to the country and, when applicable, project context.

SAMPLE MODULE: ITEM-UNIT MEASUREMENT											
ITEM CODE	ITEM NAME & condition when applicable	UNIT NAME	UNIT CODE	1.	2.	3.	4.	5.	6.	7.	8.
				Can item be measured now? YES . 1 ► Q4 NO . . . 2	Why not ? Not available right now . . . 1 <u>ITEM</u> not usually in this market . . 2 NEXT ITEM <u>UNIT</u> not usually in this market . . 3 NEXT UNIT Other, specify . . . 4 NEXT ITEM	When will IT be available? JAN . . . 1 JUL . . . 7 FEB . . . 2 AUG . . . 8 MAR . . . 3 SEPT . . 9 APR . . . 4 OCT . . 10 MAY . . . 5 NOV . . 11 JUN . . . 6 DEC . . 12 ALL RESPONSES ► NEXT ITEM	Sizes available for this unit? 1 SIZE ONLY . . 1 SMALL 2 MEDIUM 3 LARGE 4 QUARTER 5 HALF 6 FULL 7 OTHER 1, SPECIFY . . . 8 OTHER 2, SPECIFY . . . 9	PHOTO OF [ITEM]-[UNIT]. INCLUDE ALL SIZES IN ONE PHOTO	Which type of scale was used? PERSONAL DIGITAL SCALE . . . 1 MARKET SCALE . . . 2	MEASUREMENT #1 Weight (Grams)	MEASUREMENT #2 Weight (Grams)
21	Corn, whole on cob	Piece	1								
21			1								
21			1								
21		Heap	2								
21			2								
21			2								
21	Corn, whole no cob, no husk	Piece	1								
21			1								
21			1								
21		Heap	2								
21			2								
21			2								
60	Banana	Piece	1								
60			1								
60			1								
60		Bunch	5								
60			5								
60			5								
60		Stalk	6								
60			6								
60			6								
D	Mango	Piece	1								
61			1								
61			1								
61		Heap	2								
61			2								
61			2								
62	Rice	Cup	1								
62			1								
62			62								
62		Pail	62								
62			62								
62			62								
62		Packet	1								
62			1								
62			62								

ANNEX III. EVALUATING PHOTO QUALITY FOR NSU REFERENCE BOOKS

Figures 7 - 10 below are examples of properly photographed items and units. Figures 11 - 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 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.

Figure 7 — Correctly Photographed *Sahins* of Rapeseed



Source: World Bank LSMS Team.

Figure 8 — Correctly Photographed *Tasas* of Sunflower Seeds



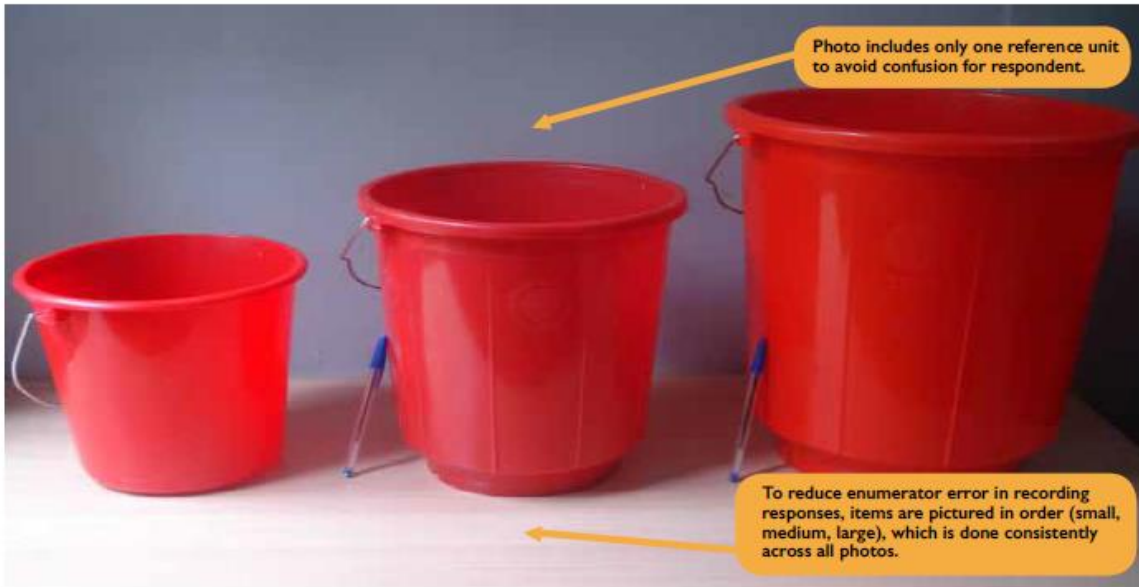
Source: World Bank, LSMS Team.

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



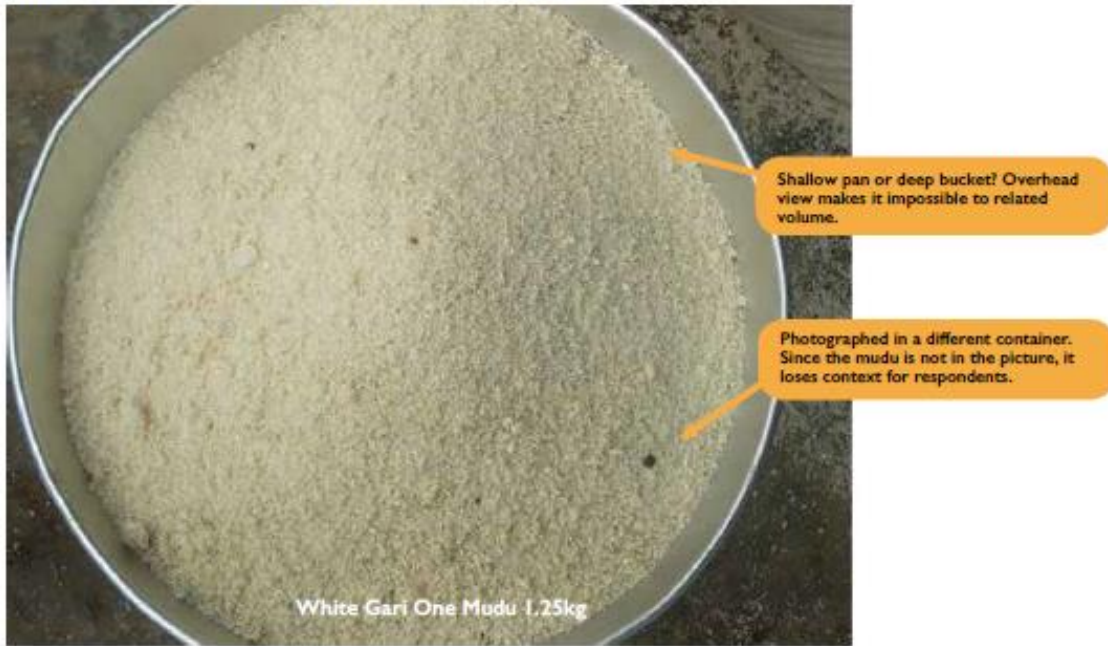
Source: World Bank, LSMS Team.

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



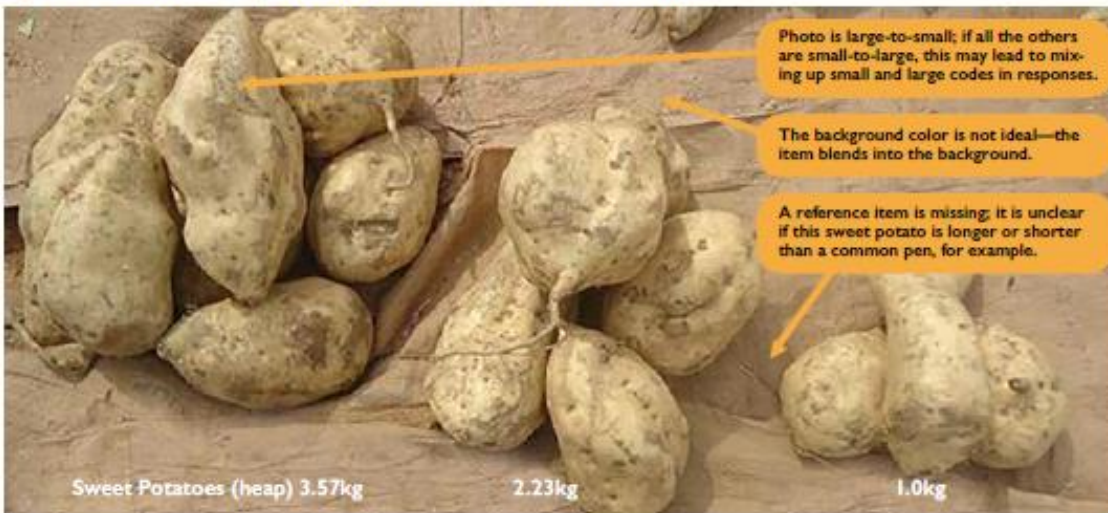
Source: World Bank, LSMS Team.

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



The items in the background are very distracting. Photos should focus on only the item in question, to avoid confusion.

Source: World Bank, LSMS Team.

Figure 14 — Incorrectly Photographed Baskets



Two different pictures are joined together, each taken from a different angle and distance. This makes it harder to relate the size of objects in the different pictures.

Not clear which basket is small, which is medium, which is large.

Source: World Bank, LSMS Team.