FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Sampling Guide for Beneficiary-Based Surveys for Select Feed the Future Agricultural Annual Monitoring Indicators

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Abbreviations and Acronyms

BBS	beneficiary-based survey
BFS	Bureau for Food Security (USAID)
DHS	Demographic and Health Surveys
EA	enumeration area
F	U.S. Department of State's Office of U.S. Foreign Assistance Resources
FANTA	Food and Nutrition Technical Assistance Project
FEWS NET	Famine Early Warning Systems Network
FFP	Office of Food for Peace (USAID)
FFPMIS	Food for Peace Management Information System
FFS	farmer field school
FG	farmer group
FTFMS	Feed the Future Monitoring System
GPS	global positioning system
IFPRI	International Food Policy Research Institute
IP	implementing partner
IPTT	indicator performance tracking table
LQAS	lot quality assurance sampling
LSMS	Living Standards Measurement Studies
M&E	monitoring and evaluation
MCHN	maternal and child health and nutrition
MICS	Multiple Indicator Cluster Surveys
MOE	margin of error
PBS	population-based survey
PDA	personal digital assistant
PIRS	Performance Indicator Reference Sheet
PPS	probability-proportional-to-size sampling
RiA	Required if Applicable
SOW	scope of work
SRS	simple random sampling
USAID	U.S. Agency for International Development
USG	U.S. Government

PART 1

INTRODUCTION

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CHAPTER

1. Purpose and Background

1.1 Purpose of the Sampling Guide on Beneficiary-Based Surveys

This guide provides technical guidance on the design and use of beneficiary-based surveys (BBSs) to support the collection of data for agriculture-related annual monitoring indicators. The guide is intended for use mainly by U.S. Agency for International Development (USAID) Feed the Future implementing partners (IPs), including USAID Office of Food for Peace (FFP) development food assistance project awardees.

BBSs are conducted among a sample of a project's direct beneficiary population.[1,2] This is in contrast to population-based surveys (PBSs), which are conducted among a sample of the entire population living within a project's area of coverage. Typically, PBSs are used in the Feed the Future context for baseline studies, interim assessments and midterm and final performance evaluations to monitor progress and to see if there has been change over time at the population level in key outcomes and impact indicators. In contrast, BBSs are typically used in the context of project monitoring to ensure that project implementation is rolling out as expected and that project interventions are on track for achieving their intended outcomes and targets in the direct beneficiary population. The results of such monitoring exercises can be used to inform decisions about project strategies and to make corrections to project components if monitoring data show that they are not on track.

Data in support of agriculture-related annual monitoring indicators can be collected either through a project's routine monitoring systems or through specialized periodic BBSs. All Feed the Future IPs have routine monitoring systems in place to collect basic process, output, and outcome data relating to their projects, to support the tabulation of output and outcome indicators on (ideally) all direct beneficiaries of the projects.[3] Often data collection through routine monitoring occurs simultaneously with project

[1] This guide uses the term "project" to refer to FFP-funded development food assistance projects and to non-FFP-funded activities under broader Feed the Future projects. See USAID Automated Directives System glossary for the definitions of project and activity (https://www.usaid.gov/who-we-are/agency-policy/glossary-ads-terms).

[2] Direct beneficiaries are those who come into direct contact with the set of interventions (goods or services) provided by the project in each technical area. Individuals who receive training or benefit from project-supported technical assistance or service provision are considered direct beneficiaries, as are those who receive a ration or another type of good. These should be distinguished from indirect beneficiaries, who benefit indirectly from the goods and services provided to the direct beneficiaries, e.g., members of the household of a beneficiary farmer who received, for example, technical assistance, seeds and tools, other inputs, credit, or livestock, or neighboring farmers who observe technologies being applied by direct beneficiaries and elect to apply the technology themselves.

[3] Note that it is not always feasible to collect data on all of a project's direct beneficiaries, e.g., when the number of beneficiaries is very large.

implementation, and such data are collected by community members, government workers, or project monitoring and evaluation (M&E) staff.

Because of the complexities involved in conducting BBSs, Feed the Future IPs should, when possible, collect data in support of agriculture-related annual monitoring indicators through routine monitoring systems. Nevertheless, there are various scenarios (discussed in detail in Chapter 4 of this guide) that may necessitate conducting periodic BBSs to collect these data. This guide aims to provide a technical roadmap for IPs wanting to design and plan for BBSs to collect data in support of agriculture-related annual monitoring indicators under such scenarios. The guide focuses on four such Feed the Future indicators that are considered more challenging in terms of the associated data collection.

1.2 Background

The U.S. Government (USG) Feed the Future Initiative has identified a comprehensive set of annual monitoring indicators where each indicator has an associated Performance Indicator Reference Sheet (PIRS) that provides the information needed to gather data and report on the indicator.[4] In fiscal year 2012, FFP, which is part of Feed the Future,[5] adopted many of these annual monitoring indicators to track performance of development food assistance projects and to allow USAID to more comprehensively capture Feed the Future results.[6] The revised set of Feed the Future FFP annual monitoring indicators is classified into the following sectors: Agriculture and Livelihoods, Maternal and Child Health and Nutrition (MCHN), Resilience, and Gender. Feed the Future FFP also developed a handbook with the complete set of PIRSs for all of its annual monitoring indicators.[7]

Feed the Future requires all IPs to report annually on all indicators that relate to the various sectors for which their projects have relevant components or interventions. Most Feed the Future IPs have interventions in more than one of the four sectors listed above. Since data collection mechanisms are often determined by project delivery systems, which vary according to the various sectors,[8] the data collection mechanisms may vary by indicator.

Although the majority of the Feed the Future annual monitoring indicators can be collected through projects' routine monitoring systems, there are some indicators within the Agriculture and Livelihoods sector that (under certain circumstances) might warrant using BBSs for collection of the associated data. Consultations with USAID FFP and Bureau for Food Security (BFS) staff, as well as Feed the Future IP staff, suggested that collecting data for four particular Feed the Future annual monitoring indicators

[4] The complete set of Feed the Future non-FFP annual monitoring indicators and their PIRSs can be found in the publication "Feed the Future Indicator Handbook: Definition Sheets," which is located at http://feedthefuture.gov/resource/feed-future-handbook-indicator-definitions

[5] The remainder of this guide will make reference to the FFP and non-FFP parts of the Feed the Future Initiative as separate entities when relevant.

[6] In addition to Feed the Future non-FFP indicators, Feed the Future FFP adopted several Standard Foreign Assistance indicators from the U.S. Department of State's Office of U.S. Foreign Assistance Resources (F).

[7] The complete set of Feed the Future FFP annual monitoring indicators and their PIRSs can be found at http://www.usaid.gov/sites/default/files/documents/1866/Part%20II%20Annual%20Monitoring%20Indicators_04.13.2015.pdf

[8] Data collection mechanisms could also vary within sector. For example, some annual indicators are outputs and some are outcomes. The data for output indicators are easily gathered through routine data collection, but the data for some of the more complex outcome indicators may require a different approach.

relating to agriculture present challenges that might be overcome by using BBSs. A discussion of a few of these challenges is provided in Chapter 2.

The four indicators are:

1. Gross margin per unit of land, kilogram, or animal of selected products (henceforth referred to as "Gross Margins")
2. Value of incremental sales (collected at the farm level) attributed to USG implementation (henceforth referred to as "Value of Incremental Sales")
3. Number of hectares under improved technologies or management practices as a result of USG assistance (henceforth referred to as "Number of Hectares under Improved Technologies")
4. Number of farmers and others who have applied improved technologies or management practices as a result of USG assistance (henceforth referred to as "Number of Farmers and Others Using Improved Technologies")

The *Feed the Future Agricultural Indicators Guide*[9] focuses on these four indicators. The guide discusses conceptual, definitional, and measurement aspects of the indicators, but does not address data collection systems that might be required to gather the associated data. Furthermore, while PIRSs (which provide information on definitions, units of measurement, rationale, limitations, expected levels of disaggregation, and basic measurement notes, among other things) are available for all four of these annual monitoring indicators, they include suggestions but no detailed technical guidance on appropriate data collection mechanisms and methodologies.

Both USAID FFP and BFS have indicated that Feed the Future IPs could benefit from further specific guidance on survey data collection methodologies in support of these four agriculture-related annual monitoring indicators. This guide aims to respond to this need by providing detailed guidance on how to plan and design BBSs to support data collection for the four selected indicators, with particular attention given to the circumstances in which a BBS is indicated.[10] The majority of the remaining Feed the Future annual monitoring indicators can, in principle, be collected using project routine monitoring systems, and therefore are not the focus of this sampling guide.

[9] The Feed the Future Agricultural Indicators Guide can be found at http://agrilinks.org/library/feed-the-future-ag-indicators-guide

[10] Note that prior to drafting this guide, the USAID-funded Food and Nutrition Technical Assistance Project (FANTA) undertook exploratory work to obtain information on how project delivery systems and routine monitoring systems typically work across the various Feed the Future agricultural projects, and how and when awardees conduct BBSs.

CHAPTER

2. The Four Selected Feed the Future Annual Monitoring Indicators

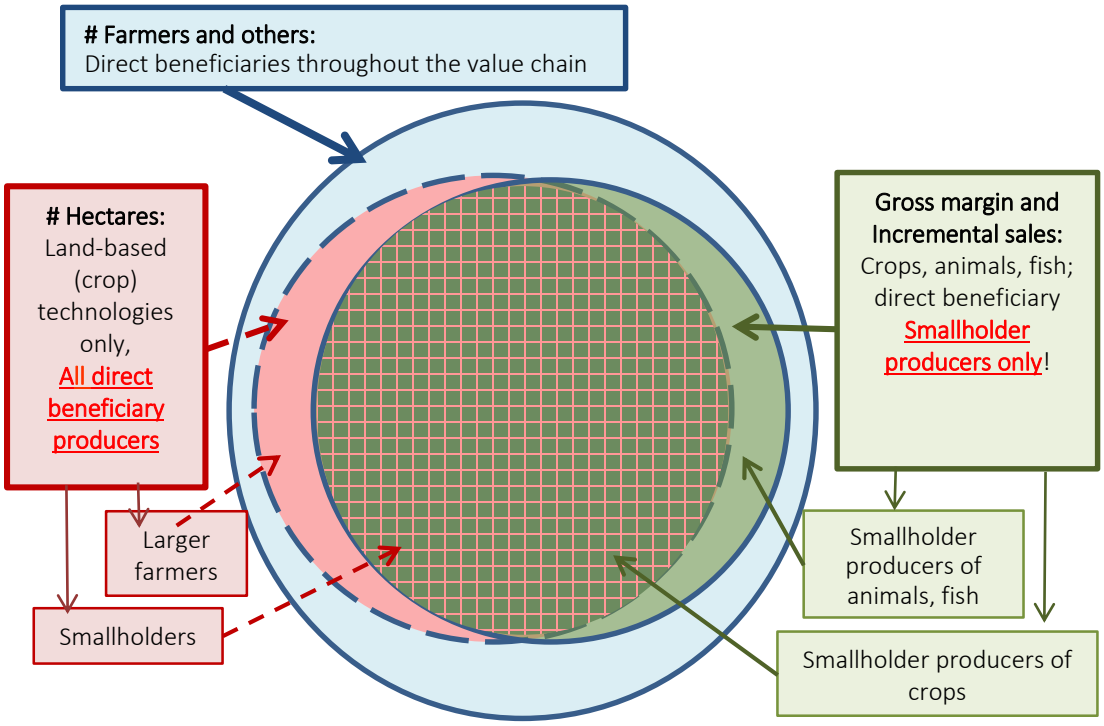
The four selected agriculture-related annual monitoring indicators are all classified by Feed the Future as "Required if Applicable" (RiA) for Feed the Future projects. This means that data need to be collected on these indicators if the projects have relevant agriculture-related interventions. This is the case for most Feed the Future non-FFP projects and for many Feed the Future FFP projects.

The types of beneficiaries covered for each of the four indicators differ. For instance, all direct beneficiary farmers, ranchers, fishers, herders, producers, entrepreneurs, managers, traders, processors (individuals only), natural resource managers, and others throughout the agriculture sector should be reported under the "Number of Farmers and Others Using Improved Technologies" indicator. The "Value of Incremental Sales" and "Gross Margins" indicators should be reported for direct-beneficiary, smallholder farmers/primary producers engaged in the agriculture sector, while the "Number of Hectares under Improved Technologies" indicator should be reported only for primary producers that are engaged in agricultural production interventions that can be measured in hectares. Therefore, the direct beneficiaries covered by the "Number of Hectares under Improved Technologies" indicator and the direct beneficiaries covered by the "Gross Margins" and "Value of Incremental Sales" indicators are different but overlapping subsets of the "Number of Farmers and Others Using Improved Technologies" indicator.

Note that although the "Number of Farmers and Others Using Improved Technologies" indicator includes more than just direct producers and extends to "others" in the value chain, **this guide focuses only on direct producers**. This is because Feed the Future projects are likely to have different mechanisms to collect data on "others" in the value chain. Similarly, **this guide focuses only on farmers and their crops**, rather than farmers and their livestock and aquaculture, for the "Number of Farmers and Others Using Improved Technologies," "Gross Margins," and "Value of Incremental Sales" indicators. The exception to this is if producer groups are the mechanism used to reach livestock or aquaculture producers, in which case some of the sampling discussion in this guide may be relevant to livestock or aquaculture producers.

See **Figure 1** and **Table 1** for visual representations of how the four indicators relate to each other.

Figure 1. How the Four Indicators Overlap



Source: Feed the Future Agricultural Indicators Guide: http://agrilinks.org/library/feed-the-future-ag-indicators-guide

Table 1. Indicators and Their Associated Beneficiaries

Indicator	Types of beneficiaries included as part of indicator definition	Subset of beneficiaries that are the focus of this guide
Number of Farmers and Others Using Improved Technologies	Producers and others engaged in agriculture (including crops, animals, and fish) and related value chains	Only producers (both small and large) engaged in land-based agriculture (crops only)
Number of Hectares under Improved Technologies	Producers engaged in land-based agriculture (crops only)	Only producers (both small and large) engaged in land-based agriculture (crops only)
Gross Margins *and* Value of Incremental Sales	Smallholder producers engaged in agriculture (including crops, animals, and fish)	Only smallholder producers engaged in land-based agriculture (crops only)

Additional detail on each of the four indicators is provided in the following four sections.

2.1 Gross Margins

The "Gross Margins" indicator has five component parts that are combined to form the overall indicator. The "Gross Margins" estimate is calculated using the following formula:

$$GM = \frac{\left(\left(\frac{VS}{QS} * TP\right) - IC\right)}{UP}$$

where:

GM = gross margins
VS = value of sales
QS = quantity (volume) of sales
TP = quantity (volume) of total production
IC = value of purchased cash input costs
UP = number of hectares planted (for crops), number of animals (for milk or eggs), number of hectares (for aquaculture in ponds), or number of crates (for aquaculture in crates)

Each of the equation's component parts is an important data point in its own right, as it provides important information that can be used to monitor project progress with respect to outcomes. Once estimates of the five components of "Gross Margins" are produced by Feed the Future IPs, they should be entered into the Food for Peace Management Information System (FFPMIS) or the Feed the Future Monitoring System (FTFMS). These systems will then automatically produce estimates for the "Gross Margins" indicator.

The collection of data supporting each of the component parts of the "Gross Margins" indicator has its own set of challenges and complexities, which are discussed in great detail in the *Feed the Future Agricultural Indicators Guide*.

One of the challenges of this indicator is obtaining an accurate measurement for the "number of hectares planted" component. While historically farmer estimates of surface area have not been considered very accurate, more recent evidence shows that farmer estimates are sometimes quite accurate, although "inaccuracies" might arise in the following ways:

- Small farmers tend to overestimate area while larger farmers tend to underestimate area.
- The accuracy of farmer estimates is reported to decrease with increasing plot size.
- The accuracy of farmer estimates of area varies with their level of familiarity with area measurement units.

Thus, in cases where farmer estimates may not render accurate results (e.g., for non-smallholder farmers or farmers with limited familiarity with area measurement units), survey implementers should consider taking direct measurements of farmer plots.

2.2 Value of Incremental Sales

The "Value of Incremental Sales" indicator measures the value of the change in sales per commodity, in one reporting year relative to a base year.[11] It shares a common component ("value of sales") with the "Gross Margins" indicator, but has an additional challenge in its computation given that two time points of data are required. In principle, the indicator can be computed by subtracting the base year's value of total sales from the current reporting year's value of total sales. That is to say, the general formula for calculating the "Value of Incremental Sales" indicator estimate is given by:

$$Value\ of\ Incremental\ Sales = \ VS_{reportingyear} - VS_{baseyear}$$

where:

$VS_{reportingyear}$ = the value of total sales for the reporting year
$VS_{baseyear}$ = the value of total sales for the base year (before project interventions started)

The base year should capture sales from direct beneficiaries (from project year 1) in the year before the interventions started (project year 0), and this base year value remains static as reporting years progress through time.

Despite the seeming simplicity of the equation, calculating the "Value of Incremental Sales" indicator is complicated by the fact that the pool of beneficiaries in the base year is usually not the same as the pool of beneficiaries in the reporting year. This is because Feed the Future IPs tend to increase the number of beneficiaries in the first few years of project implementation, and often decrease the number of beneficiaries as they phase out the project in the last year. This makes a direct comparison of total sales in the base year and total sales in the reporting year potentially misleading, since the total value of sales at each time point may be based on a different number and set of beneficiaries. For instance, if the number of beneficiaries in the reporting year is larger than the number in the base year, base year sales may be underestimated relative to reporting year sales, and therefore subtracting base year sales from reporting year sales might lead to an overestimation of this indicator. Feed the Future requires that projects report information on the number of beneficiaries at each time point so that appropriate adjustments can be made to the value of base year sales. Thus, the adjusted formula for calculating the "Value of Incremental Sales" indicator is given by:

$$Value\ of\ Incremental\ Sales\ (adj) = \ VS_{reporting\ year} - [\left(\frac{N_{RY}}{N_{BY}}\right) * VS_{base\ year}]$$

where:

N_{RY} is the number of project beneficiaries in the reporting year

N_{BY} is the number of project beneficiaries in the base year

[11] Feed the Future non-FFP projects use the term "baseline value of sales" in the associated PIRS for this indicator, while Feed the Future FFP projects use the term "base year value of sales."

The estimates of total sales for the two time points of data and the number of beneficiaries at each time point should be entered into the FFPMIS or the FTFMS. These systems then automatically produce estimates for the "Value of Incremental Sales" indicator using the adjusted formula.

2.3 Number of Hectares under Improved Technologies

The "Number of Hectares under Improved Technologies" indicator has the same measurement issues as the "number of hectares planted" component of the "Gross Margins" indicator discussed above (e.g., farmer estimates that lead to potential inaccuracy). Although there would appear to be an added measurement complexity due to the necessity to restrict the estimate to only the land mass under improved technologies or management practices, once a farmer has identified that an improved technology is used on a particular crop, the PIRS guidance suggests that projects should assume that 100% of the hectares planted with that crop have the technology applied to it.

2.4 Number of Farmers and Others Using Improved Technologies

The "Number of Farmers and Others Using Improved Technologies" indicator shares many of the issues relating to the other three indicators discussed above.

PART 2

ROUTINE MONITORING VERSUS BENEFICIARY-BASED SURVEYS

CHAPTERS

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CHAPTER

3. Comparison of Routine Monitoring and Beneficiary-Based Surveys

3.1 Overview

This chapter provides a brief description of routine monitoring and BBSs, as well as the salient features and advantages of each approach. A comparison of the two approaches gives Feed the Future IPs a sense of what is entailed in terms of resources, time, systems, and skills so that they can make informed decisions about which approach is most appropriate given programmatic circumstances and constraints.

In general, performance monitoring systems collect, transmit, process, and analyze data for project performance tracking, planning, and decision making. The components are part of a management information system that includes: data collection and aggregation tools, databases, reporting tools, and standardized indicator definitions. They may also include data quality assurance tools or checklists. Data collected in performance monitoring systems help determine if project implementation is running on schedule and meeting interim targets during the life of the project. Mid-course corrections can be made if it appears that, based on an analysis of the collected data, a project or a component of a project is not on track. Data are typically collected in support of such systems through either **routine monitoring** or **beneficiary-based surveys**.

3.2 Description and Features of Each Approach

3.2.1 Routine Monitoring

Data collected through **routine monitoring** is usually undertaken by specialized project staff (such as M&E personnel or agricultural extension workers), either concurrently with the implementation of project interventions (such as during farmer group [FG] meetings or agricultural extension worker/technical staff field visits to farmers' individual plots) or through regularly scheduled visits that are not undertaken concurrently with implementation of interventions but that coincide with key points in the production cycle. However, data are typically aggregated monthly or quarterly (or even more frequently given the advent of cloud technology) to provide timely information for project tracking, planning, and management.

The data collected during routine monitoring typically support indicators at the output[12] and lower-level outcome[13] levels, and all relevant data relating to indicators are ideally collected from **all** direct project beneficiaries. As such, routine monitoring requires a sufficient number of field staff (e.g., agricultural extension and M&E staff, community development workers, volunteers, and promoters) to ensure

[12] Output indicators are those that reflect direct products of the activity (e.g., number of trainees, number of meetings held) that result from the combination of inputs and processes. Inputs are the sets of resources (e.g., staff, financial resources, space, project beneficiaries) brought together to accomplish the project's objectives. Processes are the sets of activities (e.g., training, delivering services) by which resources are used in pursuit of the desired results.

[13] Outcome indicators are those that reflect the set of beneficiary-level results (such as changes in practices, skills, or knowledge) that are expected to change from the activity's interventions. Note that, for example, lower-level outcomes might reflect changes in knowledge, whereas higher-level outcomes might reflect changes in practices.

sufficiently frequent contact with all beneficiaries throughout the year to collect all necessary data. This may be particularly difficult for projects with a large number of beneficiaries, where a large number of staff might be necessary to fulfill all the data collection needs.

In the case where there is a visit to the beneficiary farmers' plots as part of routine monitoring, direct measurement of various data points, such as hectares, can easily be taken. This may be an advantage, as, in many cases, it results in improved accuracy of such data. In contrast, data collected when FGs convene typically rely on farmer estimation/recall, which can result in data that are less accurate as noted earlier (although it usually is of acceptable accuracy for performance monitoring purposes).

3.2.2 Beneficiary-Based Surveys

Beneficiary-based surveys refer to specialized periodic surveys conducted among the project direct beneficiary population. In the case of agricultural projects or agricultural components of projects, data are collected on a random sample or subset of project beneficiary farmers during a visit to their households and/or farming plots—although it is also possible to take a random sample of FGs from among all those convened for those projects that use FGs as a project delivery mechanism, e.g., farmer field schools (FFSs). The collection of data is typically not linked to project implementation as it usually is for routine monitoring, except in the instance of sampling FGs mentioned above.

The surveys are usually implemented a fixed number of times per year (usually 1–4 times) and conducted at periods during the year that are often related to the agricultural cycle (e.g., planting, harvesting, sale) and the reporting cycle. In order to appropriately collect information on beneficiaries who are part of different project interventions (for example, agriculture production strengthening versus livelihood strengthening), separate surveys may be required if the beneficiary registries are different for these interventions. However, for both routine monitoring and BBSs, care is needed to aggregate the data across different time points in the year to ensure that no double counting of data from individual beneficiaries occurs.

3.3 Advantages of Each Approach

3.3.1 Advantages of Routine Monitoring

Some key advantages to using routine monitoring as a means of collecting annual monitoring data are listed below:

- In project designs where routine monitoring and project interventions are integrated into one process (such as in projects that collect data from individual farmers at the same time that FG meetings are held), **there is no need for a separate mechanism for data collection**.
- All projects have routine monitoring systems in place, regardless of whether or not they conduct BBSs. In this sense, the use of routine monitoring for data collection on annual monitoring indicators may be **less resource intensive** than the use of BBSs because, in the latter case, a separate, additional (and substantial) resource investment is required that would otherwise not be necessary.[14] However, when all annual monitoring data are collected through routine

[14] The exception to this is when projects opt to send M&E specialists to collect data from all beneficiaries at their plots several times a year as a separate and additional routine monitoring exercise, as noted earlier in the guide.

monitoring, there may also be a substantial cost to engaging an increased number of M&E staff year round.

- The collection of data through routine monitoring **does not require specialized skills in survey design and implementation** (although it does require skills in questionnaire development and design), and, therefore, there is less of a need to hire an external contractor.[15]
- Using routine monitoring, data are usually collected on all beneficiaries (i.e., a "census" of the beneficiary population is taken), and, therefore, there is no need to produce sampling weights, confidence intervals, or standard errors of the estimates,[16] as there is with BBSs. In this sense, **data analysis of data collected through routine monitoring is much simpler than data analysis of data collected through BBSs**, the latter of which typically requires the analysis of complex survey data.
- Since data collection using routine monitoring often occurs on an ongoing basis, data can more easily be collected at multiple points in the production cycle, at multiple harvests for a particular crop, or at different harvest times for a variety of crops. This will likely result in more accurate data. Multiple BBSs would need to be conducted to capture analogous data on multiple points, harvests, or crops—or, at a minimum, annually administered BBSs would need to include the scope for data recall at multiple time points throughout the year. As a result, **routine monitoring data can be fed back to project staff more frequently than with BBSs**.

3.3.2 Advantages of Beneficiary-Based Surveys

The following is a list of advantages in using BBSs as a means of collecting data in support of annual monitoring indicators:

- BBSs allow for direct measurements to be taken on key data points (such as "Number of Hectares under Improved Technologies") through a visit to the farmers' plots, and this **may result in higher-quality data**. In contrast, for projects where routine monitoring data are collected during FG meetings only and where farmer recall is used to obtain data on area, if direct measurements were desired, visits to the beneficiary farmers' plots by an agriculture extension worker would be required. While in principle project staff should visit at least a significant proportion of beneficiary plots during the year, this may not always happen in practice.[17]
- **The number of beneficiaries from whom data are collected is much smaller for BBSs than for routine monitoring** since data are collected on only a random sample (or subset) of beneficiaries for the former while data are ideally collected on all beneficiaries for the latter. It can be logistically difficult to collect, aggregate, and analyze data on all beneficiary farmers through routine monitoring for projects with a very large number of beneficiaries.

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[15] It is important to note, however, that data collection through routine monitoring requires staff with a substantial understanding of the data points to be collected and of the basic principles of questionnaire development and design, and the data collectors must have the requisite skills to record and analyze the data accurately. Therefore, even with routine monitoring, appropriate training is necessary.

[16] It should be noted that although confidence intervals and standard errors of the estimates are not required in the reporting of annual monitoring indicators for Feed the Future projects, it is a good practice to calculate them to provide a sense of the quality of the data estimates produced when using BBSs.

[17] However, in the case where field visits to farmer plots are undertaken, better-quality estimates of area may result because the project staff who collect data have a much better understanding of the farmers' plots and crops relative to data collectors from external contractors.

CHAPTER

4. When Are Beneficiary-Based Surveys Appropriate?

There are certain situations in which it is preferable to use BBSs over routine monitoring. There are other situations in which a combination of routine monitoring and BBSs is the most effective way to collect the appropriate data. This chapter outlines three scenarios for which BBSs may be warranted, either in isolation or in combination with routine monitoring.

4.1 Scenario #1: Large Project Size/Inadequate Number of Data Collection Staff

There is a number of Feed the Future projects that have tens of thousands—even hundreds of thousands—of direct beneficiary farmers. Although projects of this size frequently have larger numbers of agricultural extension workers and M&E staff, it can still be difficult from both a resource and logistical perspective to collect all relevant data on all beneficiaries. A survey with a representative sample of the beneficiary population can be an appropriate alternative in this case.

In these cases, annual monitoring data for Feed the Future projects can be collected through a combination of routine monitoring and BBSs. For example, one Feed the Future IP with a large number of beneficiaries in a variety of countries has deemed it infeasible to collect all data points on all beneficiaries through routine monitoring, despite having a large number of staff engaged in M&E activities. Therefore, this IP collects basic "count" data (such as data supporting "number of rural households benefiting directly from USG interventions") on all beneficiaries through routine monitoring, but also conducts BBSs several times a year on a sample of beneficiaries to collect some of the more complex data on production and sales in relation to the "Gross Margins," "Value of Incremental Sales," and other indicators. The survey data are sample weighted to represent the entire direct beneficiary population of farmers (more details on sample weighting is discussed in Chapter 11), and the data collected through the two mechanisms are combined and stored in a large proprietary comprehensive database.

It is important to note that data for Feed the Future annual monitoring indicators relating to other, non-agriculture sectors (e.g., MCHN and Resilience) also need to be collected and reported in the annual monitoring process. Even if a BBS is used by a project to collect data for some of the indicators related to the agricultural component, data related to other sectors may be collected either through routine monitoring or through separate BBSs, depending on the circumstances. Thus, using a BBS to collect data in relation to agricultural data may not entirely solve the issue of the data collection burden for large projects, since the number of beneficiaries under other non-agricultural components might also be very large, necessitating separate BBSs using different sample frames in those instances as well. Therefore, the development and maintenance of multiple data collection systems is necessary reality for most annual monitoring systems.

4.2 Scenario #2: Farmer Estimates of Area Considered Unreliable and Direct Measurement Preferred

Projects that integrate routine monitoring with project implementation by collecting data through FGs generally use farmer estimates to obtain information on several relevant data points. As noted earlier, in some instances (e.g., for non-smallholder farmers or farmers with limited familiarity with area measurement units), recall can be unreliable for the collection of information, specifically on hectares in support of both the "Gross Margins" and "Number of Hectares under Improved Technologies" indicators. Direct measurement via a BBS conducted at the farmers' private plots may be preferable in such instances.

It is important to keep in mind that all Feed the Future IPs must collect data for a diverse range of annual monitoring indicators, above and beyond the four agricultural indicators that are the focus of this guide. While a BBS might be the best option for collecting high-quality data for some of the more complex indicators (such as those that involve information on hectares), routine monitoring might be the preferable option of data collection for those other indicators. Each project should determine whether it would be preferable to live with less-accurate data for a few of the more complex indicators and to use routine monitoring for the collection of data on all indicators. However, in making this decision, it is important to recognize that the four agriculture-related indicators discussed in this guide are among the most important for reporting progress under Feed the Future on an annual basis.

4.3 Scenario #3: Lack of Direct Contact between a Project and Its Beneficiary Farmers

Some projects do not have a direct link with their beneficiary farmers by design, for example, project implementation that focuses on engagement with agricultural businesses, where the businesses are trained by the project using a value chain facilitation approach, and the expectation is that these businesses will in turn provide technical advice to beneficiary farmers. In these cases, using routine monitoring to collect annual monitoring data would be difficult, as the project has no direct contact with its beneficiary farmers at any point during implementation.

To address this issue, it might be possible to ask the agricultural businesses to collect the requisite annual monitoring data on behalf of the project. However, this approach may lead to low-quality data, as there is little incentive for businesses to invest in such data collection unless a business case can be made for how the information is useful to them. Therefore, in this circumstance, project implementers could carry out a BBS to collect all relevant agriculture-related annual monitoring data, provided that a comprehensive, accurate, and up-to-date list of beneficiaries exists or can be created to serve as a sampling frame.[18]

[18] Alternatively, the project could define the catchment area served by the value change actors that they are facilitating, consider all the farmers within that catchment area as direct beneficiaries, and conduct a PBS within that catchment area. However, guidance on such an approach is beyond the scope of this guide.

PART 3

BENEFICIARY-BASED SURVEYS: IMPLEMENTATION ISSUES

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CHAPTER

5. Timing and Frequency of Beneficiary-Based Survey Data Collection

The timing and frequency of BBSs are important considerations when planning for annual monitoring activities. If a project chooses BBSs as a chief vehicle for collecting data in support of annual monitoring, then the survey should be conducted at least once per year, given that Feed the Future requires annual reporting.

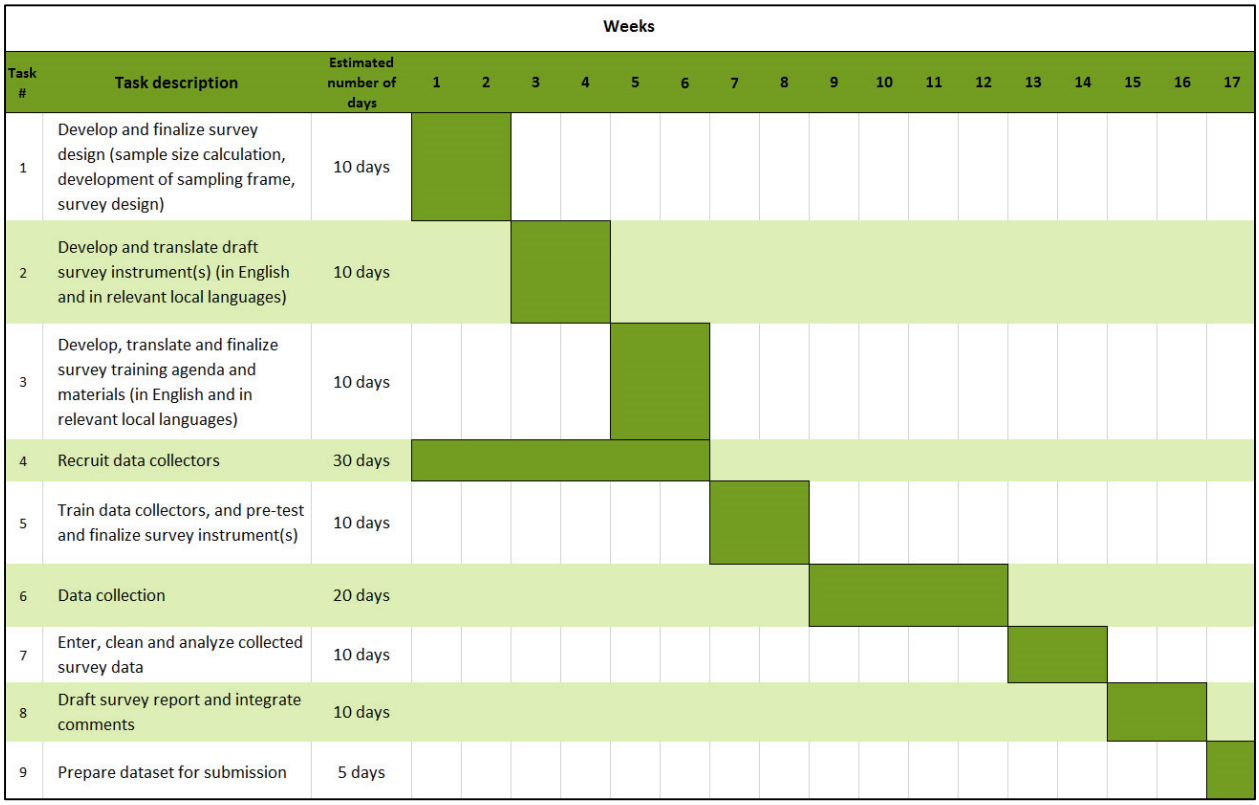
In the case of an annual BBS, 12-month recall may be used to collect all the required agricultural data. However, it may be advantageous to implement surveys more frequently in order to shorten the recall period to improve the accuracy of the data collected. For instance, a project could collect data on certain inputs and hectares at the time of planting, and could collect information on other inputs, production, and sales at or shortly following the harvest. Furthermore, if a project promotes multiple value chains corresponding to multiple crops, which can be harvested at different times of the year, it may improve accuracy to conduct separate surveys during the planting and/or harvesting periods. Finally, it might also be advantageous to collect data (and hence to conduct BBSs) several times per year for a single crop, in the event that the crop has several plantings and/or harvests in a single year.

If a Feed the Future IP decides to collect data more frequently than once a year, one approach used to decide the timing of data collection is to obtain—or map out with project beneficiaries—a seasonal calendar of agricultural-related interventions. A seasonal calendar helps highlight the critical moments of the year during which agricultural interventions occur related to the various crops in question. With the calendar in hand, the next logical step is to analyze the available resources (budget, staff, etc.) and time constraints to determine how frequently data collection can occur.

It is also useful to have an accurate sense of the time required to conduct a survey from beginning to end, particularly if a project needs to decide whether to plan one or multiple surveys in a year to correspond with specific seasonal events. A survey timeline is usually drafted in the form of a Gantt chart and provides a projection of the expected number of weeks that a survey needs from start to finish, as well as the number of days or weeks that each particular activity needs. It can help avoid common problems with planning for the survey work, such as insufficient time allocated for activities and omitting to take into account the interrelationships between activities.

The illustrative timeline in **Figure 2** provides some guidance on the minimum amount of time that should be allocated for some of the activities that are essential to carrying out a BBS. The timeline assumes that, if an external contractor is used, additional time is required at the front end to draft and advertise a scope of work (SOW), to interview and select an external firm, and to draft and sign a contract between the parties. These additional activities are not included in the timeline below, but could entail several months of work and need to be finalized before the survey can start.

Figure 2. Illustrative Timeline for a Beneficiary-Based Survey



Discussions about the timing and frequency of data collection activities should begin during the project design phase, as decisions have an impact on budgets and potentially on staffing. It is important that these decisions take into consideration time availability and resource constraints to ensure that data collection and analysis activities can be effectively and efficiently implemented.

CHAPTER

6. Issues to Consider when Outsourcing Work to an External Contractor

Depending on the circumstances, a project can elect to implement the survey internally or to hire an external contractor to implement the survey. There are distinct advantages to using an external contractor to conduct a BBS. For instance, a contractor can provide highly specialized expertise in survey methodology and data analysis techniques—skills that project staff often do not possess. An external contractor can also relieve the time pressures of implementing a survey from the IP, thereby freeing the project staff to focus on project implementation.

There are also disadvantages to using an external contractor. First and foremost, it will almost certainly be more expensive to use a contractor to implement a survey than it will be to engage in-house staff. In addition, identifying and selecting a qualified external contractor can be time consuming, and it is often difficult for project staff with limited survey experience to make informed judgments regarding the quality of proposed candidates for the work. Furthermore, the internal project staff member overseeing the activity needs to have an appropriate level of survey-related knowledge to develop the SOW for the contractor, to properly manage the work of the contractor, and to adequately review survey deliverables.

Undertaking a BBS entails a number of important activities, including:

1. Designing the sampling plan
2. Drafting the survey questionnaire instruments to elicit data on the relevant indicators
3. Developing training materials and field procedure manuals
4. Recruiting and training data collectors
5. Managing the logistical and administrative aspects of the fieldwork
6. Implementing data collection
7. Managing data entry and cleaning as well as analysis of the survey data
8. Writing the survey report and presenting the survey results

An external contractor can be hired and tasked with any or all of the required activities.[19] Any combination of splitting the responsibilities for these activities between an external contractor and internal staff members from the project is also possible. Regardless of the assigned responsibilities, it is always necessary to clearly designate an internal staff member from the project to oversee the work of the external contractor. This authority should be explicitly detailed in the SOW for the contractor, as should the process by which survey deliverables are to be reviewed and approved.

The decision to engage an external contractor to conduct a BBS is usually based on one or more of the following factors: budget, internal staff time, and internal staff expertise. Once the decision has been

[19] Note that project staff can be involved in the actual collection of data (as can external data collectors), but in this case they require special training on administering survey questionnaires and on the appropriate survey protocols in the field.

made to engage an external contractor, there are several other issues that must be given due consideration. These are outlined in the following sections.

6.1 Time and Effort Required to Procure and Manage an External Contractor

An IP must invest considerable time and effort in various elements related to the procurement of the external contractor, including:

1. Drafting and internally vetting a SOW for the external contractor
2. Advertising the SOW
3. Interviewing and selecting the external contractor
4. Drafting, reviewing, and approving the contract

It is critical that an IP consider the time needed for these essential activities (which can be several months) when deciding whether or not to use an external contractor, as the survey cannot start before they have been completed. The IP should also take into account the considerable time required for adequate management of an external contractor throughout the survey process.

6.2 Importance of a Good Scope of Work to Guide the Process

A clear and comprehensive SOW is a key element in the successful oversight of an external contractor. A good SOW helps set expectations, facilitates the management of the contractor, and provides quality control measures on survey deliverables. A shortened version of the SOW can be used to advertise for an external contractor.

The SOW should clearly delineate the responsibilities of both the contractor and the Feed the Future IP engaging the contractor. It should provide information on key survey design features and details on the expected survey activities, deliverables, and timeline. It should also clearly outline the indicator(s) for which data should be collected, as well as required disaggregates that must be reported.

A template for a SOW to advertise for or to manage a contractor undertaking a BBS can be found in Annex 1. Feed the Future IPs can use this template as a starting point and add specificity to serve their particular needs.

Feed the Future IPs can request that external firms respond to a wide variety elements in the proposals that they submit in reply to an advertised SOW. These elements help IPs make a determination on which firm is most appropriately suited to undertake the work. The elements in the proposal should include, at a minimum, a technical write-up outlining how the firm intends to undertake the work, a budget, a detailed timeline, a proposed survey team with accompanying individual CVs, and evidence of past relevant experience.

Note that the survey team proposed by the external firm should consist of key personnel with a mix of defined technical and subject matter expertise. At a minimum, the key personnel should include a survey team leader, a senior survey specialist, and a field operations manager. Annex 2 contains a set of illustrative job descriptions for each of these key personnel. Sometimes members of survey teams take

on the responsibilities of multiple roles within the team, but what is important is that all of the different required competencies are present within the team.

Application materials from contractors should always include examples of reports from past complex household and/or beneficiary-based surveys that candidate contractors have designed and implemented.

6.3 Judging the Expertise of Potential External Contractors

Priority should be placed on recruiting a contractor that has adequate internal specialization in survey methodology and questionnaire development, as well as in managing data collection in the field. A contractor needs survey expertise relating to sample size calculations, stratification, clustering, sample selection using multiple stages and unequal probabilities of selection, and sample weight creation. In addition, the contractor should have experience in implementing household and/or beneficiary-based surveys (i.e., the implementation of survey protocols, field logistics, data collection, and the oversight of data collectors) in developing countries, where ground realities for data collection can be considerably different, and often more difficult, than in developed countries.

It is often difficult for IP project staff with limited survey experience to make informed judgments regarding the quality of potential candidate firms that respond to an advertised SOW. To assist projects in assessing the appropriateness of such firms, Annex 3 of this guide contains a "Checklist for Engaging External Contractors." The checklist outlines a set of factors that projects should consider when choosing contractors from among the firms that have submitted proposals for the work.

PART 4

BENEFICIARY-BASED SURVEYS: SAMPLING FRAMES AND SURVEY APPROACHES

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CHAPTER

7. Sampling Frame Guidance for Beneficiary-Based Surveys

This chapter discusses the sampling frame and its critical importance in the survey-taking process. A sampling frame is the backbone of all BBSs. It comprises one or more complete lists of all project implementation "clusters" and/or all project beneficiaries—from which a representative sample can randomly be drawn for the survey. In this case, "cluster" refers either to the lowest level of geographic area covered by the project (typically village or community) or to FGs. Without such frame(s), it is impossible to undertake a representative survey.

A high-quality survey frame should be comprehensive, complete, and up-to-date. "Comprehensiveness" refers to the *type* of information that is included on the frame, while "completeness" refers to the *extent* to which information on all entities (i.e., villages/communities or FGs and/or beneficiaries) is reflected on the frame. It is important that the frame be actively maintained so that it will always be as current ("up-to-date") as possible. This means that the list of villages/communities or FGs in which the project operates must be kept current; if new villages/communities or FGs are integrated into the project over time, they must be added to the survey frame. This also means that beneficiary registration systems should keep close track of beneficiaries who are new entrants to the project and, if project implementers are interested in doing so, beneficiaries who are graduates from the project[20]—and the former of these should be reflected on the frame, whereas the latter should be reflected if possible. Beneficiaries who drop out from the project interventions for whatever reason (e.g., unavailability, migration, disinterest, death) should be dropped from the frame.

7.1 Information to Include on a Sampling Frame

Three survey design options for conducting BBSs are introduced below and are discussed in detail in Chapter 9.

The first survey design option uses two-stage cluster sampling, for which two separate sampling frames are required. In this case, the "first stage cluster frame" consists of the list of villages/communities[21] (or clusters) served by the project, from which villages/communities are randomly selected at the first stage of sampling. The "second stage beneficiary frame" consists of the list of beneficiaries served by the

[20] The *Feed the Future Agricultural Indicators Guide* states, "Farmers and others that have graduated from an activity remain direct beneficiaries for the duration of the activity. If IPs have the required resources to continue tracking beneficiaries after they graduate, they can be counted as long as they continue to apply technologies or practices promoted through your activity." http://agrilinks.org/library/feed-the-future-ag-indicators-guide, p. 70.

[21] PBSs often use enumeration areas (EAs) defined by the national census (rather than villages/communities) as the basis for the first stage cluster frame, because the population and/or household counts that are needed for sampling are readily available for each EA from the census. One of the difficulties in using EAs is that the correspondence between EAs and the villages/communities in which IPs work is not always straightforward. Fortunately, BBSs (unlike PBSs) need not use EAs as a basis for the first stage cluster frame given that population and/or household counts are not required for sampling. Instead, counts of beneficiaries from project records are required. Therefore, for BBSs, the villages and/or communities in which IPs work are better suited than EAs for inclusion on the first stage cluster frame.

project, from which beneficiaries are randomly selected from the sampled clusters at the second stage of sampling.

The second survey design option, which also uses two-stage sampling, requires only the first stage cluster frame prior to sampling, because the second stage beneficiary frame is created in the field through a listing operation.

The third survey design option employs a "one-stage sampling design," for which only the second stage beneficiary frame is required, from which beneficiaries are directly sampled.

A fourth survey design option is introduced in Chapter 10. This design uses two-stage sampling, where clusters are FGs that are sampled at the first stage of sampling, and where all beneficiary farmers in the selected FGs are selected at the second stage. For this survey design option, both a first stage cluster frame consisting of FGs and a second stage beneficiary frame are required.

In general, for the **first stage cluster frame** (consisting of the set of implementation villages/communities or FGs) to be considered "comprehensive," it should include, at a minimum, the following information:

- A unique ID number for the cluster (e.g., village/community or FG)
- The name of the cluster (e.g., village/community or FG)
- The location of the cluster (e.g., census geographic code or global positioning system [GPS] coordinates)
- Information on all appropriate higher-level geographic areas (e.g., province or district)
- The number of direct project beneficiaries in the cluster

For the **second stage beneficiary frame** (consisting of the population of beneficiaries served by the project) to be considered "comprehensive," it should include, at a minimum, the following information for each direct project beneficiary[22]:

- Unique individual and/or household ID number (if assigned by the project)
- Complete name
- Age and sex
- Household location (e.g., address or relative location, GPS coordinates)
- Village name/community name or FG ID to which the beneficiary belongs
- The location of the village/community or FG (e.g., census geographic code or GPS coordinates, if available)
- Higher geographic levels (e.g., province or district) in which the beneficiary resides

[22] Technically speaking, a comprehensive list of all beneficiaries is needed only in the case of one-stage sampling (third survey design option) since beneficiaries are sampled directly from this frame. For all three of the other survey design options, which entail two-stage sampling, a comprehensive list of beneficiaries is needed only for each of the sampled clusters.

There is additional information that should be included on the second stage beneficiary frame if feasible and affordable:

- Cellular telephone number, if applicable (to help locate and contact the beneficiary)
- Spouse's name, if applicable (to help contact the beneficiary)
- Date at which individual became a project beneficiary and/or graduated from the project (useful if beneficiaries enter and exit the project on a rolling basis)
- Project interventions in which the beneficiary participates (for cases where project implements a variety of interventions for different sets of beneficiaries)
- Smallholder farmer/not smallholder farmer

For the second stage beneficiary frame to be considered "complete" and "up-to-date," all current (and graduated, if feasible) direct project beneficiaries should be included on the frame, and, for each beneficiary, the above information should be accurate and recent.

It is important to highlight that only direct beneficiaries should be included on the second stage beneficiary frame, since all Feed the Future annual monitoring indicators are defined in relation to direct beneficiaries only. Indirect beneficiaries should not be included.

There should be no duplicate listings of the same beneficiary on the frame, and, for any duplicate listings that are identified, one of the listings should be eliminated. Similarly, care should be taken to ensure that unique beneficiaries with similar or identical names are distinguished and that each unique occurrence is kept on the second stage beneficiary frame. The use of beneficiary information on age, sex, and name of spouse can be used effectively to help distinguish beneficiaries with similar or identical names.

Finally, it may well occur that projects serve multiple direct beneficiary farmers from within the same household. Care should be taken to ensure that **all** beneficiaries in a given household, along with their relevant information, are included on the second stage beneficiary frame.

7.2 Beneficiary Registration Systems as a Source of Establishing Sampling Frames

Most (if not all) Feed the Future IPs have systems that register all project beneficiaries for both programmatic and reporting purposes.[23] Such systems are also essential as a foundation for routine monitoring data collection. Furthermore, they are used to develop both first and second stage sampling frames for a BBS. Therefore, it is critical that projects invest in establishing and maintaining such systems if they wish to develop reliable and representative sampling frames as a basis for conducting BBSs.

Beneficiary registration systems can vary in the type of information that they store on project beneficiaries. However, many beneficiary registration systems are not comprehensive or up-to-date, and contain either less information than is necessary to establish a sampling frame (i.e., the information

[23] Most Feed the Future FFP IPs and non-FFP IPs need to report on the indicator "Number of individuals who have received USG-supported short-term agricultural sector productivity of food security training." An exhaustive list of direct beneficiaries would also facilitate reporting on this indicator, which requires a count of unique individuals trained.

itemized in the last section) or incomplete information on all project beneficiaries. While not ideal, there are survey design options that can accommodate this shortcoming. For instance, one of the survey design options described in this guide integrates in-the-field creation of a second stage frame of beneficiaries through a "listing" process of each of the sampled villages/communities. This approach assumes that there is an accurate first stage cluster frame available from which to sample. It is important to note that there are substantial additional resources required to list in the field. Therefore, projects that use this design to conduct BBSs in a particular year should aim to improve their beneficiary registration systems so that more optimal designs can be used in subsequent years.

7.3 Frames for Multiple Beneficiary-Based Surveys Conducted in the Same Year

Because Feed the Future IPs may introduce new beneficiaries over the lifespan of a project while graduating others, beneficiary registration systems (and other project lists that serve as a basis for sampling frames) should be continually updated.[24] The dynamic nature of beneficiary registration systems can present challenges for BBSs that are conducted several times a year (as described in Chapter 5).

Combining the estimates from distinct surveys conducted at various points in a given year using different versions of a sampling frame and drawing a different set of sampled beneficiaries can be misleading. For instance, if a project elects to conduct two surveys in a particular year, one after planting (to collect data on inputs used and hectares planted) and another after harvest (to collect data on any additional inputs used later in the year, as well as production and sales), adding together the input estimates from the two time points will not be meaningful if different beneficiaries are sampled in each survey.

To minimize any potential problems that can arise from this issue, survey implementers should use the same set of sampled beneficiaries who are drawn from the sample frame used for the first survey for all surveys conducted in the same year, even if the number of project beneficiaries has changed between survey occasions. This effectively means conducting a set of longitudinal surveys on the same set of sampled beneficiaries within a given year. Since the same set of sampled beneficiaries is interviewed for each survey, the base sample weights (see Chapter 11) will be the same for each survey occasion,[25] and therefore estimates from the various surveys in the same year can be readily combined.

Once all BBSs have been completed in a particular year, the sampling frame can be updated (adding new entrants to the project while, if desired, maintaining graduated project beneficiaries) so that it may be used in BBSs conducted in the year that follows.

[24] The frequency of such updates needs to be determined in accordance with what is appropriate for each individual Feed the Future project or activity and depends on how static or dynamic the set of beneficiaries is. At a minimum, IPs should update registries annually, but more frequently is highly recommended if feasible.

[25] It is important to note that there will usually be some attrition over time when using the same set of sampled beneficiaries in a series of BBSs. Non-response at each survey occasion needs to be accounted for through a non-response adjustment (see Section 11.2 for more details), so, strictly speaking, sample weights over time using the same beneficiaries will not be identical.

CHAPTER

8. Overview of Various Approaches for Collecting Annual Monitoring Data Using Beneficiary-Based Surveys

This chapter outlines two different BBS approaches. Each approach has different time, resource, and data-quality implications. The determination of which approach is most appropriate depends on the service delivery mechanisms used by the project, as well as the circumstances surrounding the need to conduct a BBS (see Chapter 4). The two survey approaches are:

1. Household survey approach
2. FGs approach

8.1 Approach 1: Household Survey Approach

The household survey approach consists of a BBS as a distinct and separate exercise from project implementation and routine project monitoring. A random sample of beneficiaries is selected using a one-stage or two-stage design (more details on these designs are provided in Chapter 9), and interviews are held with project beneficiaries at their households and/or individual farmer plots. The data from the survey are sample weighted so that the estimates are representative of all project beneficiaries. All agricultural data related to the project's set of annual monitoring indicators that are suitable to collect through a BBS[26] may be collected through this mechanism. Data can be collected solely by interviewing the beneficiary farmer or through a combination of direct measurement, observation, and farmer interview. The combination approach is usually fairly time and resource intensive, but can yield (under certain circumstances) more accurate results for certain data points where direct measurement is used (such as for hectares).

Note that a special application of this approach can also be used to improve estimates based on farmers' recall of hectares, by taking a direct measurement of farmers' plots for a representative sample of beneficiary farmers.[27] Regression analysis can then be conducted to determine how much of a correlation exists between the two measurements (farmer estimates and physical measurements of area). A correction factor based on the correlation can then be applied to farmer estimates of area for the rest of the beneficiary farmer population for which direct measurements were not taken. Past uses of this approach by Feed the Future IPs have shown that correlations between farmer estimates and direct measurement have ranged from 0.70 to 0.95.[28]

[26] One important criterion to determine suitability of indicators for which data are to be collected is if the indicators track the activities of the same set of beneficiaries for which data are collected on the four agricultural indicators.

[27] Note that a physical measurement on land areas needs to be taken only once, unless there is reason to believe that access to land or land ownership by farmers changes substantially over the life of the project.

[28] For more details on how to improve estimates of hectares using regression analysis, see: Fermont, A. and Benson, T. 2011. *Estimating yield of food crops grown by smallholder farmers: a review in the Uganda context*. International Food Policy Research Institute (IFPRI) Discussion Paper 01097.

Approach 1 is appropriate if the project has a large number of beneficiary farmers coupled with an inadequate number of data collection staff so that it is considered infeasible to collect all agricultural data through routine monitoring (and assuming that the project does not implement interventions through FGs), as outlined in Scenario 1 of Chapter 4.

If the project is not large and visits to farmer plots are **not** a routine part of project implementation, the household survey approach is also appropriate if it is deemed essential to obtain a direct measurement on some indicators, such as those relating to hectares when dealing with non-smallholder farmers or farmers with poor familiarity with area measurement units, as outlined in Scenario 2 of Chapter 4.

This approach can also be used when the project has no direct contact with project beneficiaries for the agricultural component, as outlined in Scenario 3 of Chapter 4. The use of a BBS under the scenario of no direct contact still presents the challenge that a comprehensive, complete, and up-to-date sampling frame of beneficiaries must be available from which to draw the sample. This highlights the need for those organizations that do have direct contact with project beneficiaries (e.g., input suppliers) to develop and maintain high-quality "customer lists" from which beneficiary registration systems and sampling frames can be developed.[29] Therefore, there is likely a need for such projects to engage the businesses that they train (who in turn have direct contact with beneficiaries) to provide substantial inputs to the beneficiary registration systems.

For more details on Approach 1, see Chapter 9.

8.2 Approach 2: Farmer Groups Approach

The "farmer groups approach" uses surveys of FGs to collect the data in support of annual monitoring. In this case, one or more surveys of beneficiary farmers take place during the periodic meeting of a FG, e.g., at a FFS.

To implement this approach, a sample of FGs is selected from among all active FGs, and **all** of the beneficiary farmers (rather than a sample of them) within the selected FGs are interviewed at the next meeting of a FG.[30] From this sampled group of beneficiary farmers, data relating to the four agricultural indicators or any other agricultural outcome indicators that are relevant to the same set of beneficiaries can also be collected. The data from the survey are sample weighted so that the estimates are representative of all project beneficiaries.

Data on farmers' attributes are collected using farmer recall and estimates. Since direct measurements (e.g., on hectares) are not taken, there is no need to visit individual beneficiary households and/or farmer plots for the survey component. For this reason, it is logistically efficient to use the FG as a first stage cluster in lieu of the village or community, the latter of which is traditionally used in household surveys. Thus, the main advantage to this approach is that the survey component is less time and resource intensive than the household survey approach, as it is not necessary to locate and travel to the

[29] See the *Feed the Future Agricultural Indicators Guide,* http://agrilinks.org/library/feed-the-future-ag-indicators-guide, p. 7, for related guidance.

[30] In the Feed the Future context, there are typically 15–30 farmers in a FG and therefore it is feasible to interview all farmers within a sampled FG. In the rare cases where a FG is larger, a subsample of farmers can be interviewed. However, this will introduce an additional stage of sampling.

households or plots of farmers. However, a disadvantage is the potential loss of accuracy due to the use of farmer recall and estimates.

This approach is suitable only for those projects that use the FG approach as the agriculture service delivery mechanism for the interventions that the four agricultural indicators track. This approach addresses the challenge that projects using the FG service delivery mechanism encounter if they have a large number of beneficiary farmers coupled with an inadequate number of data collection staff, so that it is considered infeasible to collect all agricultural data through routine monitoring, and, at the same time, it is **not** deemed necessary to procure a direct measurement for data, such as hectares, since farmer estimates are considered reasonably accurate (as in the case of smallholder farmers or farmers with good familiarity with area measurement units).

For more details on Approach 2, see Chapter 10.

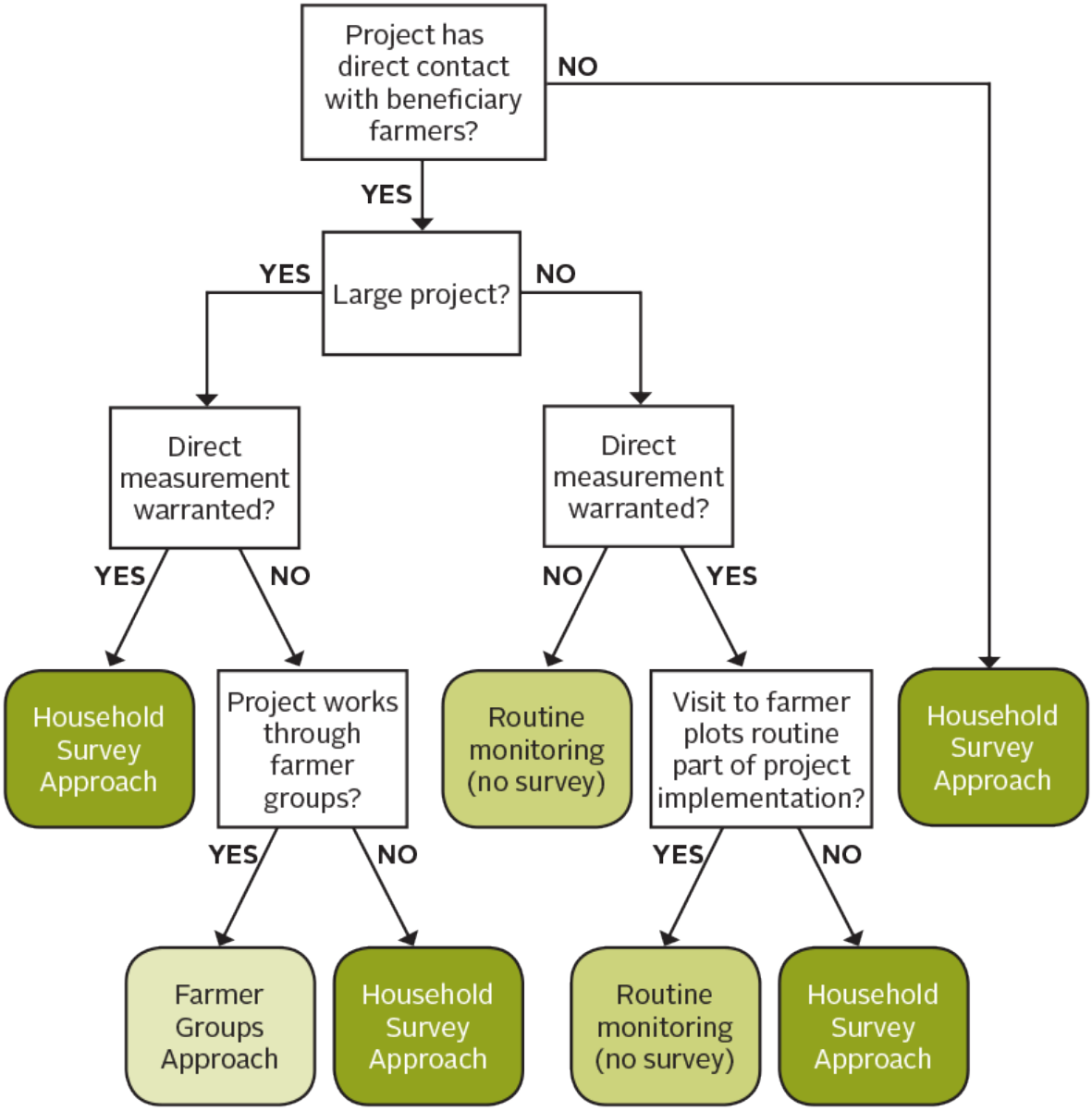
8.3 How to Choose the Right Approach

Figure 3 summarizes the decision-making process for deciding which of the two approaches is most appropriate for a given project. Note that if the project has direct contact with beneficiaries and does not have a large pool of beneficiaries and it is deemed that direct measurements are not necessary, then the best option is to collect all relevant data through routine monitoring. Alternatively, if the project has direct contact with beneficiaries and does not have a large pool of beneficiaries, but it is deemed that direct measurements **are** necessary and visits to farmer plots are a routine part of project implementation, then the best option is to collect all relevant data through routine monitoring.

8.4 Details on the Three Approaches

The next two chapters (Chapters 9 and 10) provide details on the two approaches described in this chapter. In particular, Chapter 9 provides detailed information on the various steps of the survey design process for the household survey approach. This chapter outlines three survey design options under this approach and how to choose from among them, how to calculate the sample size for the survey, how to choose the number of clusters to select, how to randomly select a sample of clusters in accordance with that number, and how to randomly select survey respondents within sampled clusters. Chapter 10 provides detailed information on the farmer groups approach.

Figure 3. Determining Which Approach Is Most Appropriate



PART 5

THE TWO APPROACHES

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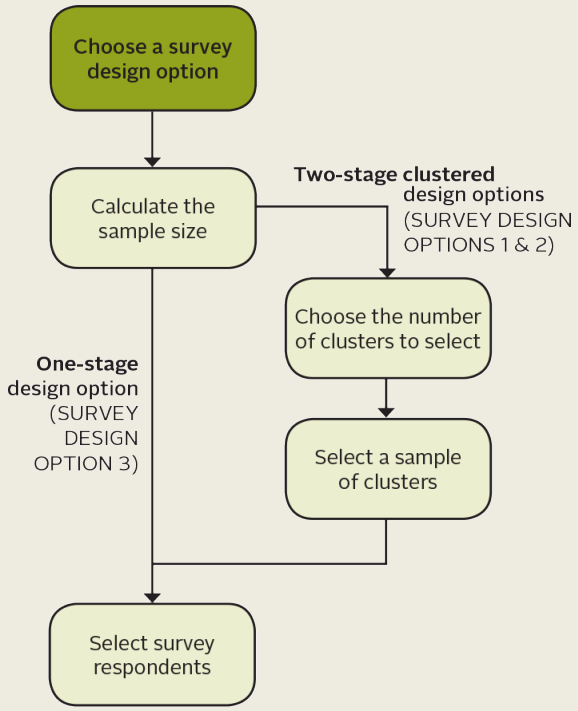
CHAPTER

9. The Household Survey Approach (Approach 1)

This chapter provides details on how to implement the household survey approach. Three survey design options are suggested for the household survey approach. The simplest survey design option involves only one stage of sample selection, while two more-complex survey design options involve clustering and two stages of sample selection. Once a survey design option is chosen (from among the three options), there are a number of additional steps to be followed. All three survey designs have two steps that are common to them: calculating the sample size and selecting survey respondents. The two more-complex survey design options have two additional steps: choosing the number of clusters to select and selecting a sample of clusters. **Figure 4a** provides a visual representation of these steps. The details for each of the steps are outlined in the sections that follow.

Figure 4a. Steps in the Approach



9.1 Choosing a Survey Design Option

The three recommended survey design options under the household survey approach are:

- **Survey design option 1:** Two-stage cluster design with systematic selection of beneficiaries
- **Survey design option 2:** Two-stage cluster design with a listing operation and systematic selection of beneficiaries
- **Survey design option 3:** One-stage design with systematic selection of beneficiaries

The following sections briefly describe each of these options.

9.1.1 Survey Design Option 1: Two-Stage Cluster Design with Systematic Selection of Beneficiaries

The two-stage cluster design with systematic selection of beneficiaries survey design option requires a **first stage cluster frame** (consisting of a complete set of project implementation clusters, i.e., villages or communities) and a **second stage beneficiary frame** (consisting of the complete list of beneficiaries within all sampled implementation clusters served by the project). At the first stage of sampling, a random sample of clusters is selected from the first stage cluster frame. At the second stage of sampling, beneficiaries from the second stage beneficiary frame for each of the sampled clusters are randomly selected and interviewed. (More details on first and second stage sampling are provided in Sections 9.4 and 9.5.)

In general, a two-stage cluster sampling design is preferred over a one-stage sampling design in most cases, since direct sampling of beneficiaries in one stage can be logistically difficult, particularly if there is a large number of clusters in which the project is implemented, and the difficulty is exacerbated if travel between them is challenging due to distance or physical conditions. To elaborate, if a project selects beneficiaries directly using one stage using systematic sampling, then, if the cluster sizes are roughly equal, the result is a random selection of an approximately equal number of beneficiaries from **almost every** cluster in which the project works. If the project operates in a large number of clusters, particularly where the clusters are geographically spread out or difficult to access, it will be costly and logistically burdensome to visit all project clusters for the purposes of survey. In this case, a two-stage cluster sampling approach may be preferable to economize on the time and resources expended because it allows for surveying in only a subset of the project clusters (rather than in all of them).

However, one of the main disadvantages of using a two-stage cluster design is that, in order to account for the increase in sampling error due to clustering, the sample size will likely have to be significantly larger than what would be required for a simple one-stage design using systematic sampling.[31] Still, if it is deemed that the cost savings and logistical ease of surveying in some, not all, clusters under two-stage sampling is a reasonable offset to the additional burden of the increased cost of a greater sample size under one-stage sampling, then a two-stage cluster design should be chosen.

9.1.2 Survey Design Option 2: Two-Stage Cluster Design with a Listing Operation and Systematic Selection of Beneficiaries

The second survey design option under the household survey approach also uses a two-stage cluster design, but has an additional listing operation between the first and second stages of sampling.

Both two-stage cluster design options require the existence of a **first stage cluster frame** (consisting of a complete set of project implementation clusters) for sample selection at the first stage. The main difference between survey design options 1 and 2 is that in option 1, the project must have a **second stage beneficiary frame** in hand before fieldwork commences, while in option 2, there is no requirement to have a comprehensive, complete, and up-to-date list of beneficiaries within all sampled clusters at the time of first-stage sampling.

For survey design option 2, the first stage sampling of clusters is identical to that of survey design option 1. However, before a second stage selection of beneficiaries occurs, a listing operation is undertaken in the field in each of the clusters selected for sampling (see Section 9.5.2 for more detailed information on listing operations). The listing can be created by walking through the sampled cluster and by identifying households in which beneficiaries reside. After the listing is created, the second stage of sampling is identical to that of survey design option 1, namely, a random systematic sample of beneficiaries within the sampled clusters is selected for interviewing.

Since an additional step—a listing operation—is needed during survey implementation, the choice of this survey option design usually necessitates a longer timeline (several days to several weeks), depending on the number of clusters that must be listed and the resources available (e.g., the number of data collectors available).

[31] In addition, data analysis is more complicated for two-stage cluster designs than it is for one-stage designs.

Generally speaking, this option is suitable when two-stage sampling is warranted (as explained in Section 9.1.1) and when a second stage beneficiary frame does not exist.

9.1.3 Survey Design Option 3: One-Stage Design with Systematic Selection of Beneficiaries

For the one-stage design with systematic selection of beneficiaries, it is essential that there be a comprehensive, complete, and up-to-date **second stage beneficiary frame** (consisting of the complete list of beneficiaries within all implementation clusters served by the project). However, unlike options 1 and 2, there is no requirement for a **first stage cluster frame** (consisting of a complete set of project implementation clusters) since there is no sampling of clusters.

In general, there are two ways to sample beneficiaries directly using one stage of sampling: systematic sampling and simple random sampling (SRS). In **systematic sampling**, the complete list of beneficiaries is ordered by cluster and a subset of the beneficiaries is selected using a fixed interval across the entire list. If the cluster sizes are roughly equal, roughly the same number of beneficiaries is selected from each implementation cluster, and every (or almost every) implementation cluster is included in the sample (assuming the sample size is greater than or equal to the number of implementation clusters). In contrast, in **SRS**, a sample of beneficiaries is selected without regard to the cluster in which they belong. In this case, one cannot determine in advance how many beneficiaries from each implementation cluster will be in the sample, or even how many of the implementation clusters will be in the sample. At the extremes, either one beneficiary or all beneficiaries might be selected from any given cluster. Depending on the sample that is drawn, this can result in fieldwork that is very costly and inefficient from a logistical point of view, given the unpredictable geographic spread of the sample. Therefore, when sampling beneficiaries directly using one stage of sampling, it is always preferable to use systematic sampling over SRS.

Survey design option 3 using systematic sampling is most suitable when there is a modest number of clusters in which the project is implemented and where travel conditions between clusters are not difficult. This is particularly true when the project covers villages within a reasonably compact geographical area and all beneficiary farmers can be accessed easily and relatively quickly. In this case, it is not logistically burdensome to use systematic sampling of beneficiaries, which may result in travel to all (or nearly all) project clusters.

When the number of clusters is large, implementing systematic sampling can become logistically challenging. For example, if a project has 65,000 beneficiary farmers across 300 clusters and wishes to sample 500 beneficiaries, then, under a one-stage systematic sampling design, the 500 beneficiaries would be sampled from the sample frame of all 65,000 beneficiaries (sorted by cluster) by selecting every 130th farmer (65,000 ÷ 500 = 130) across the 300 clusters. In this case, the resultant sample will span all or almost all of the 300 clusters and only 2–3 beneficiaries will be sampled in each cluster, which is a logistically inefficient design. Therefore, in this case, a two-stage design should be used instead. If, on the other hand, the project works in only 25 clusters, then, although it would still be necessary to visit all or almost all of the 25 clusters, 20 beneficiaries per cluster would be sampled, making it much more logistically efficient to use one-stage sampling in this case.

9.1.4 Summary of the Recommended Survey Design Options under the Household Survey Approach

Table 2 summarizes the main characteristics of the three recommended survey design options.

Table 2. Summary of the Main Characteristics of the Three Recommended Survey Design Options

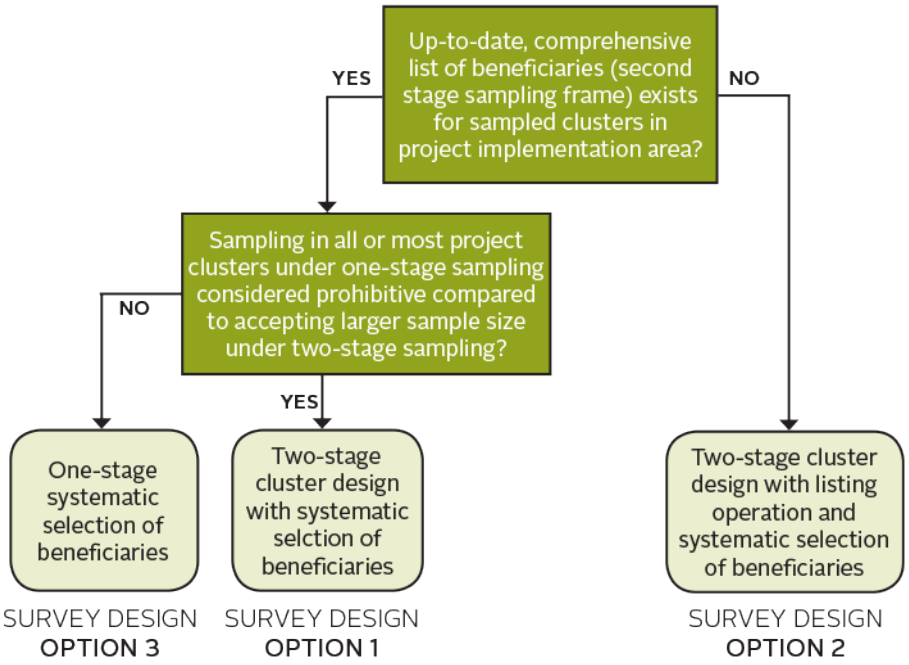
Option number	Survey design option	Sampling frame requirements	Sample size	Other implications
1	Two-stage cluster design with systematic selection of beneficiaries	Comprehensive, complete, up-to-date list of clusters and beneficiaries	Larger	More complicated data analysis (due to clustering)
2	Two-stage cluster design with a listing operation and systematic selection of beneficiaries	Comprehensive, complete, up-to-date list of clusters only	Larger	More time and resources needed due to listing operation AND More complicated data analysis (due to clustering)
3	One-stage design with systematic selection of beneficiaries	Comprehensive, complete, up-to-date list of beneficiaries only	Smaller	Easiest data analysis

The flowchart in **Figure 5** describes how two criteria lead to the choice of the appropriate survey design option.

9.1.5 A Cautionary Note on the Use of Lot Quality Assurance Sampling

There is a survey design called Lot Quality Assurance Sampling (LQAS) that is sometimes used by humanitarian and development projects, and, when properly executed, is an appropriate option to consider for projects measuring categorizations of "success" or "failure" of various initiatives. Such categorizations of success or failure can be made in each "supervision area" or other relevant geographic area related to management, using very small sample sizes—which is viewed as a substantial cost savings by survey practitioners. A byproduct of this approach is that estimates of totals at higher levels of geography (e.g., at the province or district level) can be constructed with reasonable precision by "summing the results" across these geographic areas. However, if the primary aim of a survey is to produce estimates of totals (as is the case for most Feed the Future IPs) rather than to construct categorizations of "success" or "failure," then LQAS is a logistically inefficient design because it allocates very small sample sizes to a large number of geographic areas (akin to clusters). Therefore, the survey design options discussed in the previous sections are more appropriate and survey implementers should not use an LQAS design to collect data for the agriculture-related annual monitoring indicators.

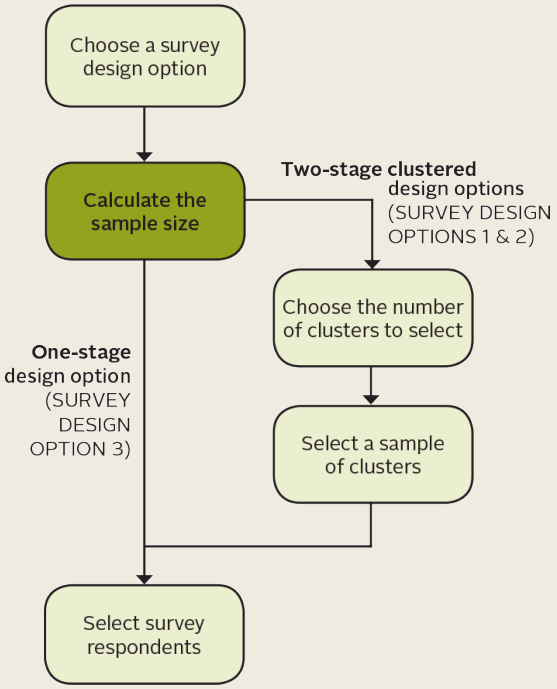
Figure 5. How to Choose the Appropriate Survey Design Option



9.2 Calculating the Sample Size for All Survey Design Options of the Household Survey Approach

After choosing the survey design option, the next step in the survey design process for the household survey approach is to calculate the sample size. This section starts by describing the different types of surveys and indicators and the different sample size calculations associated with each. The various indicators that can drive the sample size calculation are discussed, and a formula for determining the initial sample size is provided. Each of the input parameters to the initial sample size calculation is described in depth, and recommendations on how to estimate the input parameters are given. Three multiplicative adjustments to the initial sample size formula are provided, to permit the computation of a final sample size for the household survey approach. Illustrative examples are provided throughout the section.

Figure 4b. Steps in the Approach



9.2.1 Types of Surveys and Indicators

The formulas used to calculate sample size depend on two factors: the type of survey and the type of indicator.

The first factor is the **type of survey**. There are two types of surveys that are typically conducted by Feed the Future IPs: descriptive and comparative.

- The first type of survey, a **descriptive survey***,* is one in which data are collected at a single point in time in order to provide a snapshot of a situation. For these surveys, the intention is to achieve a reasonable level of precision (i.e., a small standard error) for estimators by controlling the sample size. These are typically the types of surveys that are conducted in support of annual monitoring by Feed the Future IPs.
- The second type of survey, a **comparative survey**, is one where the main aim is to conduct statistical tests of differences between estimates—typically where the underlying data are collected at different points in time (e.g., at project start and project end) and typically for indicators of proportions or means. For these surveys, the intention is provide a sample size that will control the levels of inferential errors associated with the statistical tests of differences. These are typically the types of surveys that are conducted in support of baseline and final evaluation studies, but may also be conducted at the midterm.

The two types of surveys use different formulas to calculate the overall sample size. The formulas for descriptive surveys are simpler and tend to result in smaller sample sizes than those for comparative surveys, although this is not always the case. The aim of BBSs for annual monitoring is to provide a variety of single-point-in-time estimates of indicators, where the precision of the estimates is controlled. Feed the Future projects cannot conduct tests of differences on most annual monitoring indicators over time because most annually reported indicators reflect estimates of totals and a statistical test of differences for totals does not exist. Furthermore, an increase in an indicator of a total over successive years may reflect an increase in the quantity being measured, but may also reflect an increase in the number of beneficiaries whom the project is working with—and it is difficult to disentangle the two phenomena. Therefore, survey implementers should use the formulas associated with descriptive surveys when conducting BBSs.

The second factor that influences the formula to use to calculate sample size for a BBS is the **type of indicator**. There are several types of indicators for which data can be collected through sample surveys, for example, means or averages (e.g., “Per Capita Expenditure”), proportions (e.g., “Prevalence of Children 6–23 Months Receiving a Minimum Acceptable Diet”), and totals (e.g., “Number of Hectares under Improved Technologies”).

The Feed the Future annual monitoring indicators are usually totals, although some indicators take somewhat different forms, such as differences of totals (e.g., “Value of Incremental Sales”) or complex composites of totals (e.g., “Gross Margins”). For “Gross Margins,” each of the five component parts is a total, and the five component parts are assembled together to form the overall indicator in such a way that “Gross Margins” itself is not a total, but rather a composite of these five totals.

Each type of indicator (total, mean, and proportion) necessitates a different formula for calculating the associated sample size. However, since the four focus indicators covered by this guide are totals (i.e.,

"Number of Hectares under Improved Technologies"; "Number of Farmers and Others Using Improved Technologies"), differences of totals ("Value of Incremental Sales"), and nonlinear composites of totals ("Gross Margins"), this guide recommends the use of a formula that is based on a total.

9.2.2 Calculating the Sample Size

Indicator to Use as a Basis for Sample Size Calculation

When calculating an overall sample size for a BBS, it must be kept in mind that the survey may collect data in support of a number of annual monitoring indicators, each having its own sample size requirement. However, one indicator only, from among all indicators on which data are to be collected through the survey, can determine the overall sample size for the survey. The challenge lies in selecting that indicator.

The general recommendation is that the sample size for all **key** indicators from among the indicators being collected in the survey be calculated and that the **largest sample size** resulting from all candidate sample sizes computed be chosen.

In the case of BBSs in support of agricultural projects, the recommended key indicators on which to base the sample size calculation are three of the four indicators that are the focus of this guide:

1. "Number of Hectares under Improved Technologies"
2. "Number of Farmers and Others Using Improved Technologies"
3. "Value of Incremental Sales"

While also a key indicator, because the "Gross Margins" indicator is a complex nonlinear composite of its components, deriving a formula to calculate a sample size based on this indicator is extremely complicated. To simplify the sample size calculation process, survey implementers should **not** use the "Gross Margins" indicator as a basis for the sample size calculation.

Note that two of the three candidate indicators listed above are totals, the exception being "Value of Incremental Sales," which is a difference of totals of base year sales and the current reporting year sales, adjusted for the number of beneficiaries at each time point. If the survey is being conducted to establish base year values for the project, the data relating to only one total are being collected, which is the base year's value of total sales. For subsequent years, the base year's value of sales and the number of beneficiaries at each time point are known quantities (at the time of the reporting year), and only the reporting year's sales value is considered to be an unknown, with its value to be determined through the BBS. Therefore, the "Value of Incremental Sales" indicator also reduces to a total (i.e., reporting year's value of total sales) for the purposes of sample size calculation.

Formula to Calculate the Sample Size Based on a Total

The formula for calculating the initial sample size for the estimation of indicators of totals is given by:

$$initial\ sample\ size = n_{initial} = \frac{N^2 * z^2 * s^2}{MOE^2}$$

where:

N = total number of beneficiary farmers
z = critical value from Normal Probability Distribution
s = standard deviation of the distribution of beneficiary data
MOE = margin of error

Components of the Formula

The following section provides a description of each of the components of the sample size formula given above, along with recommendations on how to estimate each of them.

Total Number of Beneficiaries (*N*). The first component of the formula is ***N***, which is the total number of beneficiary farmers participating in the relevant project interventions tracked by the above indicators at the time of the design of the survey. However, each of the three candidate indicators encompasses a slightly different universe, according to its specific definition (see Figure 1) and, for the purposes of this guide, is further limited to include the universe described in Table 1. The limited universes for purposes of this guide are:

1. For the "Number of Farmers and Others Using Improved Technologies" and "Number of Hectares under Improved Technologies" indicators, *N* includes all beneficiary producers (both smallholder and larger) engaged in land-based agriculture (say, *N1*).
2. For the "Value of Incremental Sales" and "Gross Margins" indicators, *N* includes **only smallholder** beneficiary producers engaged in land-based agriculture (say, *N2*).

Note that in theory, *N1* will always be greater than or equal to *N2* since *N2* includes only smallholder producers whereas *N1* includes producers that are both smallholder and non-smallholder. However, in practice, the universes for the indicators in #1 and #2 above are often somewhat different for Feed the Future FFP and non-FFP projects.

In the case of Feed the Future FFP projects, smallholder producers are exclusively targeted, so, in principle, the universe for the two indicators in #1 should be the same as the smallholder beneficiary producers in #2 above. However, in most Feed the Future FFP projects, only a subset of producers who participate in training on improved technologies and management practices also participate in value chain interventions for which they are expected to report on the "Value of Incremental Sales" and "Gross Margins" indicators. So from that point of view, *N1* will typically be larger than *N2* for most Feed the Future FFP projects. For this reason, it is important that Feed the Future FFP projects be able to distinguish beneficiaries not engaged in value chain interventions from beneficiaries engaged in value chain interventions so that distinct values of *N1* and *N2* are known at the time the sample size is calculated.

The situation for Feed the Future non-FFP projects is slightly different, however. Although targeting the smallholder producers is an explicit strategy of Feed the Future non-FFP projects, a small number of larger producers may also be targeted as a means of reaching and/or assisting smallholder producers. In this case, *N1* is typically somewhat larger than *N2*. Furthermore, if the sampling frames do not contain sufficient information to be able to distinguish beneficiary farmers who are smallholders from those who are not, then it will be impossible to provide a distinct value for *N2*. In this case, the recommendation is to use *N1* in place of *N2* for the purposes of calculating the sample size, since *N1* is the larger value and it is always known. The use of the larger *N1* value will result in a greater sample size for the "Value of Incremental Sales" indicator than would have been the case had *N2* been used, but this is acceptable since larger sample sizes are considered more conservative and provide greater precision to the resultant estimates.

Critical Value from the Normal Probability Distribution (*z*). The next component is ***z***, the critical value that is a fixed value from the Normal Probability Distribution, which is one of the most commonly used probability distributions in statistics and which follows the well-recognized "bell" shape. The point on the Normal Probability Distribution curve corresponding to a 95% "confidence level"[32] is typically chosen; this corresponds to a critical value of 1.96 on the Normal Probability Distribution. Therefore, Feed the Future IPs should use a fixed value of $z = 1.96$ for the purposes of calculating sample sizes in the current context.

Standard deviation (*s*) of the distribution of beneficiary data. The third component of the sample size formula is ***s***, the standard deviation of the distribution of beneficiary data. This standard deviation is a measure of dispersion in the beneficiary-level data around the central value in the sample distribution and provides an indication of how much variation there is in the individual data points. The standard deviation is expressed in the same units as the indicator itself, and can be calculated directly from survey data.

Note that in the context of Feed the Future projects, values for the standard deviation calculated from survey data will be available for the second and subsequent years that IPs undertake BBSs, since the values can be computed directly using the data from the survey(s) undertaken in the previous year. However, the first year that IPs undertake such surveys, there may be no estimates for the standard deviation available.

In the event that an estimate for the standard deviation is not available (because it is the first year of undertaking a BBS), a rough estimate can be derived using the following formula[33]:

[32] A confidence interval is a measure of the reliability of an estimate and is expressed as a range of numbers that have a specific interpretation. If a large number of surveys was repeatedly conducted on the same beneficiary population and if confidence intervals were calculated for each survey, 95% of the confidence intervals would contain the true population value for the indicator. The "confidence level" associated with such a confidence interval is 95%. A confidence interval should **not** be interpreted to mean that there is 95% probability that the true population value falls within a specific survey's confidence interval, which is a common misinterpretation. See Chapter 13 for details on how to compute confidence intervals.

[33] This approximation for the standard deviation of the distribution is derived from the fact that three standard deviations from the "central point" or mean of the distribution cover roughly 99.7 percent of the distribution, assuming an underlying Normal Probability Distribution. The entire range of the distribution (maximum − minimum) then covers roughly six standard deviations. Hence one-sixth of the entire range (maximum – minimum) equals approximately one standard deviation.

$$Standard\ Deviation\ (distribution) = \frac{(estimate\ of\ maximum\ value\ of\ indicator\ for\ an\ individual\ beneficiary - estimate\ of\ minimum\ value\ of\ indicator\ for\ an\ individual\ beneficiary)}{6}$$

Plausible maximum and minimum values for an individual beneficiary are estimated by the IP, using experience and expert knowledge as guides.

EXAMPLE A

For the "Number of Hectares under Improved Technologies" indicator, an IP might estimate that a beneficiary farmer in the project area could have a farm size that ranges between 0.5 hectares and 4.0 hectares, and may choose to apply new technologies on a portion of his or her land ranging from none of it to all of it. In this case, the minimum value of the indicator for any given beneficiary farmer is 0 and the maximum value is 4. Applying the above formula gives a standard deviation of (4 − 0) ÷ 6 = 0.667 hectares.

EXAMPLE B

For the "Value of Incremental Sales" indicator, recall that it is necessary to use only the base year's value of sale or the reporting year's value of sales in the computation of the sample size. An IP may estimate that a smallholder beneficiary farmer in a particular country could have a current year's value of sales that ranges between US$0 and US$1,200. In this case, the maximum value for the smallholder beneficiary farmer is 1,200 and the minimum value is 0. Applying the above formula gives a standard deviation of (1,200 − 0) ÷ 6 = US$200.

EXAMPLE C

For the "Number of Farmers and Others Using Improved Technologies" indicator, a beneficiary farmer will be counted as either a "yes" in terms of using the new technology (coded as a 1) or a "no" in terms of **not** using the new technology (coded as a 0). In this case, the maximum value for a beneficiary farmer would be 1 and the minimum value would be 0. Note that for this indicator, we are not measuring attributes of a beneficiary farmer (such as hectares or value of sales), but rather number of farmers themselves. This is the reason that the "attribute value" of a particular farmer is either a 0 or a 1. (The underlying statistical distribution is "Bernoulli," which means that the only values that are possible are 0 and 1 for individual farmers.) In this case, the above formula for standard deviations does not apply directly. Instead and in the absence of any other information, survey implementers can use a "rule of thumb" value of 0.5 farmers for the standard deviation (since the standard deviation from a Bernoulli distribution is 0.5, assuming that 0 and 1 are equally likely values for a given farmer to assume).[34]

Margin of error (MOE). The final component of the sample size formula is ***MOE***, the margin of error, which is the half-width of a confidence interval around the estimate of the indicator representing a total, and is expressed in the same units as the indicator used as a basis for the sample size calculation. A smaller MOE results in a larger sample size, whereas a larger MOE results in a smaller sample size.

[34] Strictly speaking, the receipt of the project's intervention might make a value of 1 more likely than a value of 0. If survey implementers feel that this is the case, a value that is greater than 0.5 and less than 1 can be used for the standard deviation, but the particular choice of value between 0.5 and 1 is subjective.

There is no generalized rule of thumb for specifying the value of the MOE to use in the sample size calculation relating to indicators of totals. However, an estimate can be obtained for the *MOE* using the following formula:

$$MOE = p * \ target\ value\ of\ indicator$$

This formula has two terms. The first term, *p*, denotes an acceptable percentage error, and is typically subjectively specified to range between 5% and 10% (expressed as $p = 0.05$ and $p = 0.10$, respectively). Specifying $p = 0.05$ will result in a sample size that is greater (and often much greater) than specifying $p = 0.10$. For purposes of Feed the Future annual performance monitoring for both FFP and non-FFP projects, $p = 0.10$ should be used, unless this results in an overall survey sample size of less than 525 beneficiaries, in which case a sample size of 525 should be adopted. More detail on this guidance is provided in Section 9.2.5. The second term, *target value of indicator*, is set by the IPs in their indicator performance tracking tables (IPTTs) as the target value for the indicator to be achieved in the year in which the survey is being conducted.

EXAMPLE A (revisited)

If we revisit the earlier example for the "Number of Hectares under Improved Technologies" indicator, we can specify that we are willing to accept 10% error ($p = 0.10$), as per the Feed the Future guidance. If we assume that we have $N = 60{,}000$ beneficiary farmers and we have set a target of 60,000 hectares under improved technologies across those beneficiaries, then $MOE = (0.10) * 60{,}000 = 6{,}000$. In other words, we are willing to accept a margin of error of ±6,000 hectares in our estimate of the total number of hectares cultivated under improved technologies across all 60,000 beneficiaries. Alternatively, if we are willing to accept 5% error ($p = 0.05$), then $MOE = 3{,}000$, but this more stringent specification would require a larger sample size.

EXAMPLE B (revisited)

Revisiting the earlier example for the "Value of Incremental Sales" indicator, suppose that we are willing to accept 10% error ($p = 0.10$). If we assume that the project targets only smallholder farmers and that every farmer is involved in value chain interventions, then $N = 60{,}000$ farmers (as in example A). If we have set a target of US$250 in sales for each beneficiary farmer, or a total target of US$250 * 60,000 = US$15,000,000, then $MOE = (0.10) *$ US$15,000,000 = US$1,500,000. In other words, we are willing to accept a margin of error of ±US$1,500,000 in our estimate of the total reporting year sales of the IPs' beneficiaries across all 60,000 farmers.

EXAMPLE C (revisited)

Finally, revisiting the earlier example for the "Number of Farmers and Others Using Improved Technologies" indicator, suppose that we then specify that we are willing to accept 10% error ($p = 0.10$). Again, if we assume that we have $N = 60{,}000$ beneficiary farmers, and we have set a target that 30,000 of them will apply new technologies, then $MOE = (0.10) * 30{,}000 = 3{,}000$. Therefore, we are willing to accept a margin of error of ±3,000 beneficiary farmers in our estimate of the "Number of Farmers and Others Using Improved Technologies."

Once all of the input parameters for sample size calculation have been specified (the total number of beneficiaries, *N*; the minimum and maximum values for the specification of standard deviation, *s*; the

target value of the indicator and the acceptable percentage error, *p*, for the specification of *MOE*), these can be inserted into the formula for $n_{initial}$ to obtain the initial sample size.

The table below provides an illustrative example of calculating the initial sample size for the "Number of Hectares under Improved Technologies" indicator using a hypothetical sample size calculator. In the example, the input parameters are specified by the user in the highlighted areas. For this example, the population of beneficiaries is set at *N* = 60,000. There is no external estimate of standard deviation available since this is the first year the BBS is being conducted, and therefore the standard deviation must be approximated. For the standard deviation computation, the minimum number of hectares is specified as 0, while the maximum number of hectares is specified as 4. This results in a standard deviation of *s* = 0.667 hectares. For the *MOE* computation, the "target value of the indicator" is specified as 1 hectare for every beneficiary (or 60,000 hectares across all beneficiaries), while the "acceptable percentage error" is specified as 10% (*p* = .10). This results in an *MOE* of 6,000 hectares. For an assumed 95% confidence level, the initial sample size is then computed to be $n_{initial}$ = 171.

SURVEY DESIGN OPTION		1 - Two-stage cluster design with systematic selection of beneficiaries		
INDICATOR		1 - Number of hectares under improved technologies or management practices as a result of USG assistance		
INITIAL SAMPLE SIZE	N	Population of beneficiaries	60,000	beneficiaries
		Estimate of standard deviation available?	NO	
		If YES, write estimate here:		
		If NO, provide best estimates of indicator		
	max	Estimate of maximum (per beneficiary)	4.00	hectares
	min	Estimate of minimum (per beneficiary)	0.00	hectares
	s	Standard deviation	0.667	= (4 - 0) / 6
	p	Margin of error (acceptable percentage error)	10%	p=.10
		Margin of error (units of precision desired)	1.00	
	MOE	Margin of error	6,000	= 0.10 x 1 x 60,000
		Confidence level	95%	
	z	Critical value from Normal Probability Distribution	1.96	
	$n_{initial}$	Initial sample size	171	$= \frac{60{,}000^2 \times 0.667^2 \times 1.96^2}{6{,}000^2}$

Relationship between Formula Components and Sample Size

The following chart summarizes the relationship between the components of the initial sample size formula (presented at the beginning of Section 9.2.2) and the resulting initial sample size:

If there is an increase in the…	…then the initial sample size:
Total number of beneficiaries (*N*)	↑ increases
Critical value (*z*)	↑ increases
Standard deviation (*s*)	↑ increases
Margin of error (*MOE*)	↓ decreases

Output of the Formula

The sample size calculation results in the total number of beneficiary farmers who need to be interviewed ($n_{initial}$) to achieve the targeted level of precision in the results (e.g., ±6,000 MOE or 10% error, in the last example). There are, however, potentially three adjustments that need to be made before the initial sample size can be considered final: an adjustment in the case of a small population of beneficiaries, an adjustment for the design effect due to clustering, and an adjustment for non-response.

9.2.3 Adjustments to the Sample Size Calculation

Adjustment for Small Population of Beneficiaries (Finite Population Correction)

The first adjustment that should be considered is called the **finite population correction** (denoted by adj_{FPC}). This adjustment decreases the sample size in cases where the initial sample size, $n_{initial}$, is 5% or more of the total number of beneficiaries, *N*. That is to say that this adjustment is required if $n_{initial}$ > = 0.05 * *N*. This usually happens when the population of beneficiaries served by the project is relatively small.[35] In these cases, the sample size can be decreased from the initial sample size ($n_{initial}$) because each new survey respondent adds a smaller amount of new information than when the population of beneficiaries is large.

This adjustment is often not necessary, as initial sample sizes are infrequently 5% or more of the underlying population of beneficiaries listed on the sampling frame. However, a check should be made to see if this is the case and if the adjustment is necessary.

If an adjustment is necessary, it is made by multiplying the initial sample size by the quantity given in the following formula:

$$adj_{FPC} = \frac{1}{\left(1 + \frac{n_{initial}}{N}\right)}$$

[35] In such cases, a BBS may not be recommended (since the project is not large) unless other conditions hold. See Chapter 4 for a discussion of the circumstances under which BBSs are appropriate.

so that the adjusted initial sample size is:

$$n_{adj1} = n_{initial} * adj_{FPC} = \frac{n_{initial}}{\left(1 + \frac{n_{initial}}{N}\right)}$$

This adjustment is required for all survey design options (i.e., options 1, 2, and 3) where the initial sample size is 5% or more of the entire population of beneficiaries.

Adjustment for the Design Effect Due to Clustering

Survey design options 1 and 2 use a two-stage cluster design. A two-stage cluster design has greater sampling error than that of the one-stage systematic sampling design of option 3. This is because survey respondents within a cluster are likely to share similar characteristics in relation to some (or all) of the indicators of interest. When this happens, the amount of new information that each new survey respondent provides from within the same sampled cluster is less than that of a new respondent using a systematic sampling design.

This increase in sampling error due to the cluster survey design must be taken into account to reach the targeted level of precision in the survey results. To do this, an adjustment to the sample size needs to be made. This adjustment is made by multiplying the adjusted sample size n_{adj1} by a quantity called the **design effect due to clustering** (denoted $adj_{designeffect}$).

Each indicator has its own separate design effect due to clustering relating to the degree of homogeneity within the cluster in relation to that particular indicator. In principle, design effects can be calculated only after a survey has been conducted. However, they can be estimated using auxiliary information before a survey has been conducted, for the purposes of adjusting the sample size for the survey. The recommended practice for estimating the cluster design effect is to look to survey reports that have been conducted using the same (or similar) indicators on the same (or similar) survey population and ideally using the same sample design (in particular, the same number of beneficiaries interviewed per cluster).

In the event that there are no previous surveys to use as a reference, a longstanding rule of thumb is to use an estimate of $adj_{design\ effect}$ = 2 for the design effect for BBSs that use one level of clustering (as is the case in this guide). Survey implementers should follow this rule of thumb if no other source of information with information on design effects is available prior to conducting the survey. As mentioned earlier, in subsequent BBSs, Feed the Future IPs should use design effects calculated from previous surveys.

This adjustment is required only for survey design options 1 and 2 because design option 3 does not use clustering.

After applying the adjustment for the design effect due to clustering, the adjusted sample size, n_{adj2}, can be expressed as:

$$n_{adj2} = n_{adj1} * adj_{designeffect} = n_{initial} * adj_{FPC} * adj_{designeffect}$$

Adjustment for Anticipated Individual Non-Response

Another adjustment that needs to be made relates to the **anticipated individual non-response** (denoted by $adj_{non\text{-}response}$). In all surveys, it is expected that some percentage of individuals selected for the survey will be unreachable, unavailable, or unwilling to respond to any or all of the survey questions; this is called individual non-response.

Despite the best efforts of interviewers, there is usually some residual non-response that remains, even after several attempts to complete an interview with the beneficiary selected for the sample. To ensure that the targeted number of beneficiaries actually completes interviews despite individual non-response, the initial sample size is pre-inflated by multiplying by the inverse of the expected response rate so that the resultant sample size after fieldwork is as close as possible to the targeted initial sample size.

The expected response rate can be estimated using information from past survey reports drafted by other organizations conducting surveys in the same geographic area and with the same (or similar) survey population as a guide. Such information might also be found in reports from large-scale internationally sponsored surveys, such as the Demographic and Health Surveys (DHS), the Living Standards Measurement Studies (LSMS), or the Multiple Indicator Cluster Surveys (MICS). However, use of these sources may overestimate potential non-response, because project staff is likely to have an established relationship with and knowledge of direct beneficiaries who are the survey respondents, and therefore beneficiaries are more likely to respond. Even if project staff is not directly involved in data collection, they can apprise beneficiaries of the upcoming survey and can urge them to participate.

If no past information is available on non-response rates, a generally accepted rule of thumb is to assume an estimated response rate of 90%–95%. That is to say, if a response rate of 95% is assumed, then the sample size should be multiplied by $adj_{non\text{-}response}$= 1/0.95. If there are reasons to believe that the response rate will be low (e.g., if the planned number of attempts to reach selected respondents is low, if the length of the survey questionnaire is long, or if there is known heavy migration causing high rates of absenteeism), then it is best to assume a response rate that is closer to 90%. However, for BBSs, in the absence of these conditions, Feed the Future recommends assuming an anticipated response rate of 95% given the project staff's established relationship with the beneficiaries.

This adjustment is required for all survey design options (i.e., options 1, 2, and 3).

The final sample size (denoted by n_{final}), which is a product of the initial sample size and all three adjustments (where applicable) then becomes:

$$n_{final} = n_{initial} * adj_{FPC} * adj_{design\ effect} * adj_{non-response}$$

9.2.4 Final Sample Size

The sample size is final after all necessary adjustments are made to the initial sample size ($n_{initial}$). **Table 3** summarizes the adjustments to the initial sample size that need to be considered for each survey design option.

Table 3. When to Use the Different Types of Adjustments

Adjustment	Type of adjustment	Survey design option 1	Survey design option 2	Survey design option 3
1	Finite Population Correction (if $n_{initial}$ > = 0.05 * *N*)	✓	✓	✓
2	Design Effect Due to Clustering	✓	✓	
3	Individual Non-Response	✓	✓	✓

The formulas for the final sample size for each survey design option are given in **Table 4**. Note that for the third survey design option, $adj_{design\ effect}$ is not needed. Also note that it is important that the finite population correction be carried out first; the other two corrections are interchangeable in terms of order.

Table 4. Final Sample Size Formulas for the Three Survey Design Options

Option	Survey design	Final sample size formula
1	Two-stage cluster design with systematic selection of beneficiaries	$n_{final} = n_{initial} * adj_{FPC} * adj_{design\ effect} * adj_{non-response}$
2	Two-stage cluster design with a listing operation and systematic selection of beneficiaries	$n_{final} = n_{initial} * adj_{FPC} * adj_{design\ effect} * adj_{non-response}$
3	One-stage design with systematic selection of beneficiaries	$n_{final} = n_{initial} * adj_{FPC} * adj_{non-response}$

The illustrative example provided earlier for the "Number of Hectares under Improved Technologies" indicator is continued as an illustration to demonstrate the use of the three adjustments, and the results are given in the table on the next page.

For the first adjustment, the finite population correction is not necessary because the initial sample size ($n_{initial}$ = 171) comprises only 0.3% of the beneficiary population size (*N* = 60,000). Therefore, the initial sample size of 171 remains unchanged.

For the second adjustment, there is no external information on the design effect from previous similar surveys. Therefore, for the purposes of the sample size calculation, an estimated design effect of 2 is specified. This adjustment due to the design effect then doubles the initial sample size from 171 to 342.

For the third and final adjustment, there is no external information on the non-response rates available from previous similar surveys. Therefore, for the purposes of the sample size calculation, an anticipated response rate of 95% is specified. The multiplicative adjustment due to non-response then increases the sample size to 360, which is the final sample size (n_{final}). Note that if the final sample size is a fraction, it

is necessary to round up to the next nearest integer to obtain a final resultant figure, as indicated in the final row of the example.

SURVEY DESIGN OPTION		1 - Two-stage cluster design with systematic selection of beneficiaries		
INDICATOR		1 - Number of hectares under improved technologies or management practices as a result of USG assistance		
INITIAL SAMPLE SIZE	N	Population of beneficiaries	60,000	beneficiaries
		Estimate of standard deviation available?	NO	
		If YES, write estimate here:		
		If NO, provide best estimates of indicator		
	max	Estimate of maximum (per beneficiary)	4.00	hectares
	min	Estimate of minimum (per beneficiary)	0.00	hectares
	s	Standard deviation	0.667	= (4 - 0) / 6
	p	Margin of error (acceptable percentage error)	10%	p=.10
		Margin of error (units of precision desired)	1.00	
	MOE	Margin of error	6,000	= 0.10 x 1 x 60,000
		Confidence level	95%	
	z	Critical value from Normal Probability Distribution	1.96	
	$n_{initial}$	Initial sample size	171	$= \frac{60{,}000^2 \times 0.667^2 \times 1.96^2}{6{,}000^2}$
ADJUSTMENT 1		Use adjustment 1? (survey designs 1,2,3.. and if % initial sample size of survey population >5%)	NO	
Finite population correction	$n_{initial}$ / N	% sample of survey population	0.3%	
		Adjusted sample size (1)	171	
ADJUSTMENT 2		Use adjustment 2? (survey designs 1,2)	YES	
Design effect		Design effect	2.00	
		Adjusted sample size (1,2)	342	= 171 x 2
ADJUSTMENT 3		Use adjustment 3? (survey designs 1,2,3)	YES	
Non-response		Non-response rate	5%	
		Adjusted sample size (1,2,3)	360	= 342/(1 - 0.05)
FINAL SAMPLE SIZE	n_{final}	Final sample size	360	= roundup(360)

9.2.5 Determining the Overall Sample Size for the Survey

As mentioned earlier, to arrive at an overall sample size for the survey, the recommended practice is to calculate the final sample size for all candidate agriculture-related indicators outlined in Section 9.2.2 and then to choose the **largest sample size** from among those computed. It is very important that survey practitioners budget sufficiently so that they are able to support data collection from the largest sample size generated from among the key indicators. If a smaller than optimal sample size is used for the survey, the precision of some of the annual monitoring indicators for which estimates are desired will suffer.

In the example below, the final sample size has been calculated for three candidate indicators: "Number of Hectares under Improved Technologies," "Value of Incremental Sales," and "Number of Farmers and Others Using Improved Technologies," using a variety of input parameter values. The resulting sample sizes are 360, 517, and 809, respectively. In this case, it is clear that the largest sample size is 809 beneficiary farmers, corresponding to the "Number of Farmers and Others Using Improved Technologies" indicator.

Therefore, the final overall sample size for the survey will be fixed at n_{final} = 809. This means that the BBS will set out to conduct 809 interviews on randomly selected beneficiary farmers for all annual monitoring indicators relating to farmers. Because the largest sample size is chosen as the overall sample size for the survey, it will meet and exceed the needs of the other two indicators, "Number of Hectares under Improved Technologies" and "Value of Incremental Sales."

	N	*max*	*min*	*s*	*p*		*MOE*	*z*	$n_{initial}$				n_{final}
INDICATOR	Population of beneficiaries (N)	Estimate of maximum (for s)	Estimate of minimum (for s)	Standard deviation (s)	Acceptable percentage error (for MOE)	Target value of indicator (for MOE)	Margin of Error (MOE)	Critical Value (z)	Initial Sample Size	Finite Population Correction needed?	Design effect	Non response rate	Final sample size
1 - Number of hectares under improved technologies or management practices	60,000	4	0	0.67	10%	60,000	6,000	1.96	171	No	2.00	5%	360
2 - Value of incremental sales	60,000	1,200	0	200.00	10%	15,000,000	1,500,000	1.96	246	No	2.00	5%	517
3 - Number of farmers who have applied improved technologies or management practices	60,000	1	0	0.50	10%	30,000	3,000	1.96	385	No	2.00	5%	809

Note that Feed the Future requires that both FFP and non-FFP IPs produce estimates for the three indicators above according to specified disaggregates. The "Number of Hectares under Improved Technologies" and "Number of Farmers and Others Using Improved Technologies" indicators require disaggregated estimates by type of technology (several may be specified) and sex of beneficiary (male versus female for the latter indicator, male versus female versus joint for the former indicator), whereas the "Value of Incremental Sales" indicator requires disaggregated estimates by type of commodity only.

This means that if, for instance, there are three improved technologies, then Feed the Future requires reporting on the "Number of Farmers and Others Using Improved Technologies" for each of the three technologies. While it would be ideal to ensure precision for the indicator estimate for each of the three

technology disaggregates at the same level as that for the overall estimate for the indicator, this would entail undertaking a separate sample size calculation for each of the three technologies disaggregates. Such a calculation would mean taking into account the input parameters specific to disaggregates implied by each technology type (e.g., the total number of beneficiaries for disaggregates and the target value of the indicator at the level of the disaggregate population of beneficiaries). More importantly, to ensure the precision level is achieved at the disaggregate level, it would be necessary to sample the appropriate number of beneficiaries for each of the technology types. This would be possible only if there is information on the second stage beneficiary frame available relating to technology type used by each beneficiary, so that beneficiaries utilizing each technology type can be specifically targeted for sampling. However, it is very unlikely that such information would be available on the second stage beneficiary frame for most disaggregates needed and, therefore, in most cases, it will be infeasible to ensure precision for disaggregates at the same level as the overall estimates.

The only exception to this is disaggregated estimates by sex, where information on the sex of the beneficiary is often available on the frame. However, a sample size calculation for males and females separately would substantially increase the overall required sample size, making estimates at such levels of precision costly. For instance, in the example above, a separate sample size calculation for males and females may result in 809 sampled beneficiaries for each category of males and females, for a total sample size of 1,618. Increasing the overall sample size twofold (in this example) would drive up the cost of the survey substantially. Therefore, survey implementers should not produce estimates of indicators by their required disaggregates based on separate sample size calculations. Instead, they should compute the estimates of disaggregated indicators based on the portion of the overall sample size that happens to fall into the category of disaggregates, and accept the loss in precision. For instance, In the above example, if we assume that the overall sample size for the survey is 809 of whom 500 respondents are males and the remainder are females, then the disaggregated estimates by male and female should be based on the reduced sample sizes of 500 and 309, respectively, even though there will be a loss in precision for these estimates. However, IPs may decide that it is worth the additional investment of resources to collect more precise sex-disaggregated data at some points in the project. For example, an IP might consider making the additional investment to document more precisely sex differences every second year.

Another issue that should be considered when collecting data for the three indicators mentioned above is the differing universes of beneficiaries that are relevant to the indicators. As mentioned earlier in this chapter, the situation is different for Feed the Future FFP IPs and Feed the Future non-FFP IPs. For Feed the Future non-FFP IPs, if the overall sample size for the survey is 809 (as in the example above), then 809 beneficiaries will be sampled from the frame of beneficiaries. The sample will include both smallholder and non-smallholder producers alike. Data will be collected for both types of producers in support of the indicators “Number of Hectares under Improved Technologies” and “Number of Farmers and Others Using Improved Technologies.” However, the non-smallholder producers must be screened out in the field for the purposes of collecting data on the “Value of Incremental Sales” and “Gross Margins” indicators since, for these indicators, only smallholder producers are relevant.[36] This means that there will be fewer than 809 producers from whom data are collected in support of the latter two indicators.

[36] See Section 9.2.2 for a description of the differing scenarios for Feed the Future FFP versus non-FFP projects, as well as Figure 1 and Table 1 in Chapter 2 for a description of the various universes for the indicators.

However, in general, Feed the Future non-FFP projects target very few larger (non-smallholder) producers, and so only a few non-smallholder producers will be screened out in the field. In the example given above, the sample size requirement of 517 beneficiaries for the "Value of Incremental Sales" indicator would likely still be met in this situation.

For the Feed the Future FFP projects, if the overall sample size for the survey is 809 (as in the example above), then 809 beneficiaries will be sampled from the frame of beneficiaries. The sample will include both producers involved in value chain interventions and producers not involved in value chain interventions. Data will be collected for both types of producers in support of the "Number of Hectares under Improved Technologies" and "Number of Farmers and Others Using Improved Technologies" indicators. However, only a subset of producers who participate in training on improved technologies and management practices also participate in value chain interventions for which they are expected to report on the "Value of Incremental Sales" and "Gross Margins" indicators. Therefore, the producers not involved in value chain interventions must be screened out in the field for the purposes of collecting data on these two indicators.[37] This means that there will be fewer than 809 producers from whom data are collected in support of these two indicators. Feed the Future FFP projects may in some cases target relatively fewer value chain producers than non-value chain producers as beneficiaries, and so a substantial number of non-value chain producers may be screened out in the field. In the example given above, the sample size requirement of 517 beneficiaries for the "Value of Incremental Sales" indicator may or may not be met in this situation. In some cases, there will be a shortfall of sample and the survey implementers must simply accept the reduced precision implied for the indicator.

Finally, and in light of the discussion above, Feed the Future recommends that IPs adopt a minimum overall sample size for the survey of 525 beneficiaries. That is to say n_{final} should be 525 or more after taking into account the three adjustments to $n_{initial}$ and assuming an anticipated response rate of 95%. If the actual response rate encountered in the field is 95%, there will be completed interviews for 500 sampled beneficiaries. In the example above, the final sample size for "Number of Hectares under Improved Technologies," "Value of Incremental Sales," and "Number of Farmers and Others Using Improved Technologies," is 360, 517, and 809, respectively. If, instead, the final sample sizes had been 360, 517 and 492, respectively, then the Feed the Future recommendation would be to adopt a minimum overall sample size for the survey of 525 beneficiaries (or 500 beneficiaries after taking into account non-response).

A minimum final sample size of 525 (or 500 after non-response) beneficiaries is recommended based on the need to:

- Ensure reasonable precision for Feed the Future-required disaggregates, given that each category of disaggregate will have a sample size of less than 525 (or 500 after non-response), as discussed in the preceding paragraphs

[37] Although some beneficiaries need to be screened out in the field (i.e., non-smallholders for Feed the Future non-FFP IPs and non-value chain producers for Feed the Future FFP IPs for the "Value of Incremental Sales" and "Gross Margins" indicators), there is no need to make a sample weight adjustment to compensate for this screening process. Sample weight adjustments are needed when random selection takes place. In this case, a subset of sampled beneficiaries is screened out because they are not relevant to the indicators that are being measured, so there is no random sub-selection taking place. See Chapter 11 for more details on sampling weighting.

- Compensate for the possible diminished sample size for the "Value of Incremental Sales" and "Gross Margins" indicators due to the fact that some sampled beneficiaries may be screened out in relation to these indicators, as discussed in the preceding paragraphs
- Ensure reasonable precision for district or other subproject-level geographic areas, should the IPs wish to produce these for their own internal monitoring needs

9.2.6 Updating Elements of the Sample Size Formula in Future Survey Rounds

The sample size calculation for BBSs will most likely result in a different sample size for each round.[38] Several of the input parameters of the final sample size formula given earlier in the guide (which comprises the initial sample size and the three adjustments) may be unknown, and therefore they may need to be estimated at the planning stages the first time a project implements a BBS for collecting data in support of agriculture-related annual monitoring indicators. For subsequent rounds of surveys, these input parameters can be directly computed from the survey data in the prior round. Such input parameters include:

- Standard deviation
- Design effect for clustering
- Anticipated response rate

For the second round of BBSs, values for these input parameters derived from the results of the first survey round should be used. This will ensure a more accurate sample size calculation in the second round. For the third round of BBSS, values derived from the results of the second survey should be used—and so forth until the end of the project.

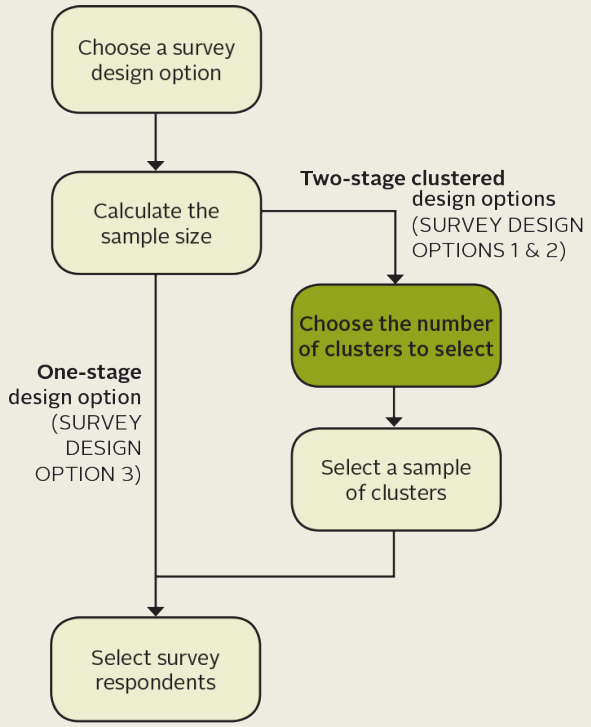
Note also that the size of the survey population of beneficiaries (*N*) and the target values for the indicators (used in the computation of *MOE*) are also likely to change from one survey round to the next, given that project recruitment and graduation tends to be a dynamic process. Therefore, the updated value of *N* and the target values for the indicators should be reflected in subsequent survey rounds for the purposes of the sample size calculation.

[38] A "round" of BBSs is defined as all BBSs (one or more) that take place within 1 year. All surveys conducted within the same year should use the same set of sampled beneficiaries over the various time points. Therefore, once a sample size is calculated for the first survey in a year, the sample size remains the same for subsequent surveys within the same year or round. See Section 7.3 for more details.

9.3 Choosing the Number of Clusters to Select for Survey Design Options 1 and 2 of the Household Survey Approach

After the sample size has been determined, the next step in the survey design process for the household survey approach is to choose the number of clusters to be randomly selected at the first stage of sampling and to determine how much of the final sample size to allocate to each of the clusters. This is relevant only to survey design options 1 and 2 as only they employ a two-stage cluster design.

Figure 4c. Steps in the Approach



In a two-stage sampling design with a given sample size, there is no prescriptive formula for determining how many clusters to choose and how many beneficiaries to choose within each cluster. There are competing interests in terms of what is most operationally expedient versus what is most statistically efficient.

On one hand, for operational expediency, it is clearly optimal to select the smallest number of clusters possible, with greater sample size per cluster (assuming a given sample size). When a smaller number of clusters is selected, the time and cost of transportation to, from, and in between the clusters are decreased—and potentially the number of data collectors can also be decreased. However, the survey efficiency decreases, as measured by an increase in the design effect.

On the other hand, for statistical efficiency, it is recommended to select the smallest number of beneficiaries possible from each cluster, and therefore to select the largest number of clusters, for a given sample size. This is because each additional survey respondent within the same cluster adds a decreasing amount of new information, assuming that clusters tend to be homogeneous in terms of the characteristics of the beneficiaries who reside within.

Given these opposing considerations, a compromise must be struck, and the two considerations must be balanced against each other.

To make an appropriate decision on the number of clusters and the number of beneficiaries to allocate per cluster, the following attributes must be weighed against one another:

1. Adequate number of available interviewers
2. Available transportation and lodging options (in the event that interviewers have to stay overnight in a sampled cluster)
3. Ease of access to all potential sampled clusters
4. Adequate budget
5. Reasonable time constraints

Possessing as many of the above attributes as possible translates into the ability to sample a greater number of clusters to ensure greater statistical efficiency. However, each survey will potentially face a different set of constraints, and it is not possible to provide a definitive recommended number of clusters to select in each instance.

It is possible, however, to provide a rule of thumb concerning the number of sampled beneficiaries to allocate to each sampled cluster. A range of 15–35 beneficiaries for each selected cluster is appropriate because, in most cases, this represents a logistically feasible number of beneficiaries per cluster to sample without inducing a design effect that is larger than roughly 2.

Based on this "15–35 beneficiaries per cluster" rule of thumb, one can then use the following approach to decide on the actual number of clusters and beneficiaries per cluster to choose.

STEP 1. Divide the final sample size (n_{final}) by *b*, the minimum and maximum points of the rule of thumb range (15 and 35, respectively), to obtain *m*, a range for the numbers of clusters to choose. The resultant numbers of clusters, *m*, must be rounded up (since it is not possible to visit a fraction of a cluster). The following is an example:

Final sample size	n_{final}	809 beneficiaries	
# beneficiaries per cluster to select	b	min=15	max=35
# clusters to select	m = round(n_{final} / b)	54	24
Actual sample size	n_{actual} = b * m	810	840

In this example, the final sample size calculated was 809 beneficiaries. The number of beneficiaries that a data collection team could interview per cluster ranges from a minimum of 15 to a maximum 35 (according to the rule of thumb), while the number of clusters that correspond to carrying out a minimum of 15 interviews per cluster and a maximum of 35 interviews per cluster is 54 and 24, respectively. The actual sample size is computed by multiplying *b* by *m*. Note that the actual sample size achieved at the endpoints of the range in the table above does not correspond exactly to 809, due to the rounding that takes place in *m*.

STEP 2. Choose the largest number of clusters within the range for *m* (24–54 in the above example) that best conforms to the logistical considerations listed earlier. For example, if the overall target sample size is 809, it may be decided, using the table above and considering project constraints, that 40 clusters should be chosen. This decision might be based on, for instance, the fact that the budget allows for engaging eight survey teams each to undertake interviewing in five clusters, and it is deemed that the survey work can be completed over a period of 5 weeks given the accessibility of the terrain in the area. Surveying in *m* = 40 clusters means that $b = round(\frac{n_{final}}{m}) = 21$ beneficiaries per cluster will be selected, for an overall expected sample size of $n_{actual} = 840$ (= 40 * 21).

STEP 3. Check to ensure that for the number of beneficiaries per cluster chosen, most (but not necessarily all) clusters on the first stage cluster frame have at least the minimum required number of beneficiaries. For instance, in the example in Step 2, most clusters on the first stage cluster frame need to have at least 21 beneficiaries. If most clusters do not have a minimum of 21 beneficiaries, choose a slightly larger number of clusters (*m*) and a slightly smaller number of beneficiaries (*b*) per cluster until this criterion is met for most (but not necessarily all) clusters on the frame. Note that it may not be worth adjusting the combination until the criterion is met for **all** clusters on the frame because a few "outlier" clusters may require an adjustment of the combination of *b* and *m* that results in a very large number of clusters (*m*) and a very small number of beneficiaries per cluster (*b*), which, in turn, would generate logistical inefficiencies in the fieldwork. In such cases, it is preferable to live with the shortfall of beneficiaries sampled in the particular outlier cluster, if that cluster happens to be selected in the sample. This approach may lead to a slightly smaller overall sample size than the actual (or final) projected sample size, but should not radically alter the precision of the survey results, particularly considering that the expected sample size of 840 considerably exceeds the target sample size of 809.

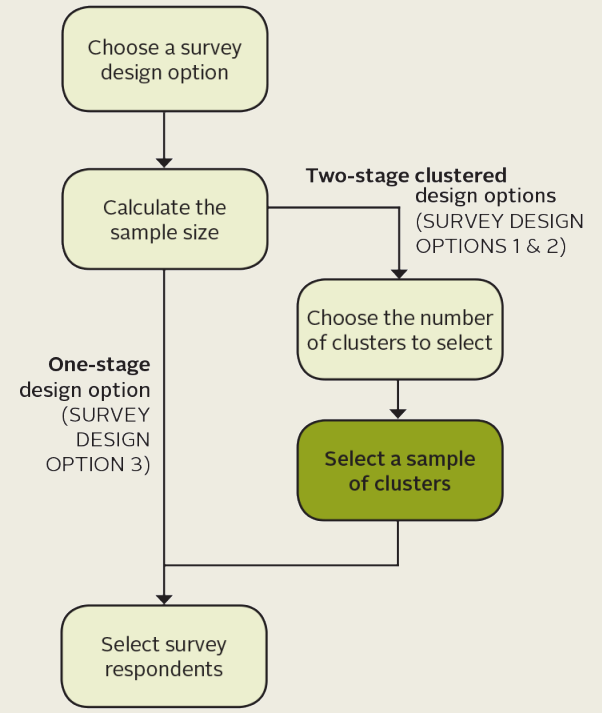
There are a few issues to keep in mind when using this process.

1. For Step 1, the range of 15–35 beneficiaries (*b*) is a suggested rule of thumb, but not a rigid rule. A smaller or greater number can be used in cases where it is appropriate (e.g., due to time or budget constraints, or when it is foreseen that a greater or lesser number of interviews can be completed by a team per day). However, it is advisable to avoid exceeding 35 beneficiaries per cluster if possible, because a larger number of beneficiaries per cluster will unduly drive up the design effect of the survey and in turn will compromise the precision of the estimates resulting from the survey.
2. Since the recommendation is to round up the resulting value of *b* (Step 2), the actual sample size (n_{actual}) will always be somewhat larger than the final sample size (n_{final}). However, this increase in the sample size should not create a significant burden on the budget, and it should be understood that additional sample always improves the precision of the survey results.

9.4 Selecting a Sample of Clusters for Survey Design Options 1 and 2 for the Household Survey Approach

After the number of clusters to be randomly selected has been determined, the next step in the survey design process for the household survey approach is to randomly select a sample of clusters from all the project implementation clusters. As a reminder, this step is relevant only for survey design options 1 and 2 because these two options use a two-stage cluster design and this step corresponds to the first stage of sampling.

Figure 4d. Steps in the Approach



In most instances, the method used to randomly select a sample of clusters at the first stage of sampling is called **systematic probability-proportional-to-size sampling**, or **systematic PPS sampling**. In general, PPS sampling selects clusters according to a "size measure" that is related to the indicators of interest, which in the case of the household survey approach is the total number of project beneficiary farmers in each cluster.

Therefore, the minimum information that is required for using systematic PPS sampling at the first stage of sampling is a comprehensive list of clusters (i.e., villages or communities) in which beneficiary farmers reside and a count of the number of beneficiary farmers in each cluster (to be used as a size measure). If this sampling frame does not contain a count of the number of beneficiary farmers per cluster for all of the clusters, it will not be possible to use systematic PPS sampling at the first stage, and an alternative method called **fractional interval systematic sampling** may be used instead.

For survey design option 1, it is assumed that there is complete information on beneficiaries in each cluster on the second stage beneficiary frame and therefore that there is also complete size information on the first stage cluster frame regarding the number of beneficiaries in each cluster. Therefore, systematic PPS sampling can and should be used at the first stage of sampling. However, for survey design option 2, it is assumed that there is no up-to-date and comprehensive list of beneficiaries within all implementation clusters served by the project (i.e., no second stage beneficiary frame), and so "size" information on a first stage cluster frame may or may not exist. Therefore, for survey design option 2, either systematic PPS sampling or fractional interval systematic sampling should be used at the first stage, depending on the available information on the first stage sampling frame.

9.4.1 Systematic PPS Sampling

The majority of surveys that use survey design options 1 and 2 will likely use systematic PPS sampling to select the sample of clusters at the first stage of sampling, assuming that there is size information on the first stage cluster frame.

In general, using PPS sampling ensures that clusters with a greater number of project beneficiaries have a greater chance of being selected from the frame, while clusters with fewer project beneficiaries have a smaller chance of being selected from the frame. It is an efficient way of sampling if the number of beneficiaries per cluster varies greatly across all the clusters on the sampling frame.[39] Systematic PPS sampling is a special variant of PPS sampling that is simpler to implement than other types of PPS sampling.

The steps to select a sample of clusters using systematic PPS sampling are given below. The steps can be carried out using any appropriate software application. By way of example, the syntax provided is what would be used in Microsoft Excel.

STEP 1. Create a list of all clusters in the project implementation area. This is essentially the first stage cluster frame described in Chapter 7. Information for each cluster on the list should include the following:

- A unique ID number for the cluster
- The name of the cluster (e.g., village or community)
- The location of the cluster (census geography, GPS coordinates, etc.)
- Information on all appropriate higher-level geographic areas (e.g., province or district)
- The number of direct project beneficiaries in the cluster

STEP 2. Order the list of clusters by a chosen geographic level. This can be done in any way, as long as all clusters in one geographic area are next to each other in the list and the choice of geographic level by which to order the clusters has relevance with respect to project implementation. For instance, if a Feed the Future IP operates in distinct districts, then clusters should be grouped together by district.

The reason for ordering clusters geographically before systematic PPS selection of clusters is to achieve "implicit stratification." Implicit stratification increases the chances that at least some sampled clusters fall in each of the geographic areas (e.g., districts, provinces, or departments) encompassed by the project—although it is not **guaranteed** that all geographic areas will have at least one sampled cluster. Using implicit stratification ensures that more of the overall variability is captured in the sample. Furthermore, it facilitates disaggregation of the results by geographic area, since there will be some (albeit an unplanned number of) sampled clusters in each (or at least in most) of the geographic areas.[40]

STEP 3. Calculate a cumulative total number of beneficiaries. Create a new column on the first stage cluster frame that contains a cumulative total number of beneficiaries per cluster. This column of cumulative totals is used for selecting the sample of clusters. The first row of the cumulative total equals the number of beneficiaries in the first cluster on the list. The second row of the cumulative total equals

[39] Even if the number of beneficiaries per cluster does not vary greatly across clusters, it may still be useful to use PPS sampling at the first stage as a way of ensuring a self-weighting design. If PPS sampling is used at the first stage sampling of clusters and systematic sampling with an identical sample size of beneficiaries in each sampled cluster is used at the second stage of sampling, then the overall sampling weights across the two stages can be shown to be constant or "self-weighting."

[40] Note that the disaggregated results will have a lower level of precision than the non-disaggregated results. This is because each geographic area will have a smaller sample size than that of the total project area.

the number of beneficiaries in the second cluster **plus** the number from the first row. This pattern of accumulation continues in the same way through to the end of the list. The following is an example.

List of all clusters (ordered by region)

Cluster number	Region	Cluster name	Number of beneficiaries per cluster		Cumulative total of beneficiaries
1	Central Region	Kvothe	6		6
2	Central Region	Gumbo	13	*+ 6 =*	19
3	Central Region	Pancho	27	*+ 19 =*	46
4	Central Region	Glokta	22	*+ 46 =*	68
5	Shattered Plains	Rainbow's End	21	*+ 68 =*	89
6	Shattered Plains	Furculita	27	*+ 89 =*	116
7	Shattered Plains	Stanka	25	*+ 116 =*	141
8	Shattered Plains	Stormlight	26	*+ 141 =*	167
9	Shattered Plains	Deepness	26	*+ 167 =*	193
10	The North	Black Dow	9	*+ 193 =*	202
11	The North	Logan	12	*+ 202 =*	214
12	The North	Tul Duru	33	*+ 214 =*	247
13	The North	Bast	34	*+ 247 =*	281
14	The North	Kaladin	34	*+ 281 =*	315
15	The North	Arya	35	*+ 315 =*	350

In this example, the clusters are ordered by region (Central Region, Shattered Plains, and The North), and the total number of beneficiaries across all clusters is 350 (which is the value in the last row of the cumulative total column).

STEP 4. Calculate a sampling interval. The sampling interval (denoted by *k*) is calculated by dividing the total number of beneficiary farmers in all implementation clusters (denoted by *N* in Section 9.2.2) by the number of clusters to select (denoted by *m*), where the value of *m* is determined as per the instructions in Section 9.3. For instance, if *N* = 350 and *m* = 4,[41] then the sampling interval is 87.5.

$$sampling\ interval = k = \frac{total\ number\ of\ beneficiaries\ in\ all\ clusters\ (N)}{number\ of\ clusters\ to\ select\ (m)}$$

[41] Note that the value of *N* = 350 is artificially small since most IPs work with considerably more beneficiaries than that across their entire project (i.e., in the tens of thousands or hundreds of thousands). Similarly, the value of *m* = 4 sampled clusters is artificially small as many more clusters will likely need to be selected at the first stage of sampling to achieve a minimum sample size of 525. The small numbers were used for illustration purposes only.

STEP 5. Calculate a random start. The random start (denoted by *RS*) determines the first cluster to select. It is calculated by choosing a random number greater than or equal to 0 and less than the sampling interval (*k*). The following is the formula to use to calculate the random start using the Microsoft Excel function $rand(\,)$:

$$random\ start = RS = rand(\,) * sampling\ interval$$

The Excel function *rand*( ) generates a random (fractional) number greater than or equal to 0 and less than 1. To compute the random start *RS*, this random number is multiplied by the sampling interval. For instance, if the sampling interval is 87.5 (from above) and the random number is 0.7146, then the random start will be *RS* = 0.7146 * 87.5 = 62.53.

STEP 6. Select the first cluster. The first cluster to select according to this scheme will be the one that corresponds to the value of the random start. To do this, identify the pair of consecutive clusters in the list for which the cumulative total corresponding to the first cluster is less than the random start and for which the cumulative total corresponding to the second cluster is greater than or equal to the random start. Choose the second cluster in the pair. The following chart provides an example.

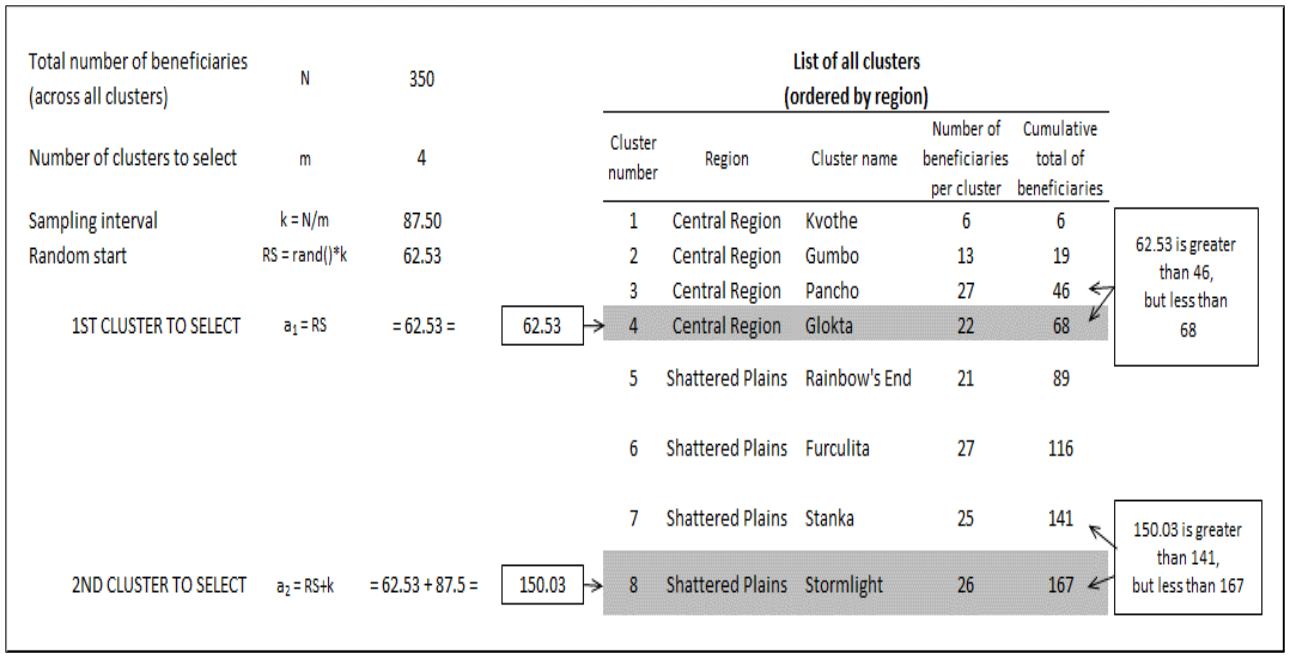
				List of all clusters (ordered by region)				
Total number of beneficiaries (across all clusters)	N	350		Cluster number	Region	Cluster name	Number of beneficiaries per cluster	Cumulative total of beneficiaries
Number of clusters to select	m	4		1	Central Region	Kvothe	6	6
Sampling interval	k = N/m	87.50		2	Central Region	Gumbo	13	19
Random start	RS = rand()*k	62.53		3	Central Region	Pancho	27	46
1ST CLUSTER TO SELECT	a_1 = RS	= 62.53 =	62.53	4	Central Region	Glokta	22	68

62.53 is greater than 46, but less than 68

In the example above, since the random start (62.53) is greater than 46 (corresponding to cluster 3) and less than 68 (corresponding to cluster 4), cluster 4 (Glokta) is selected as the first cluster in the sample.

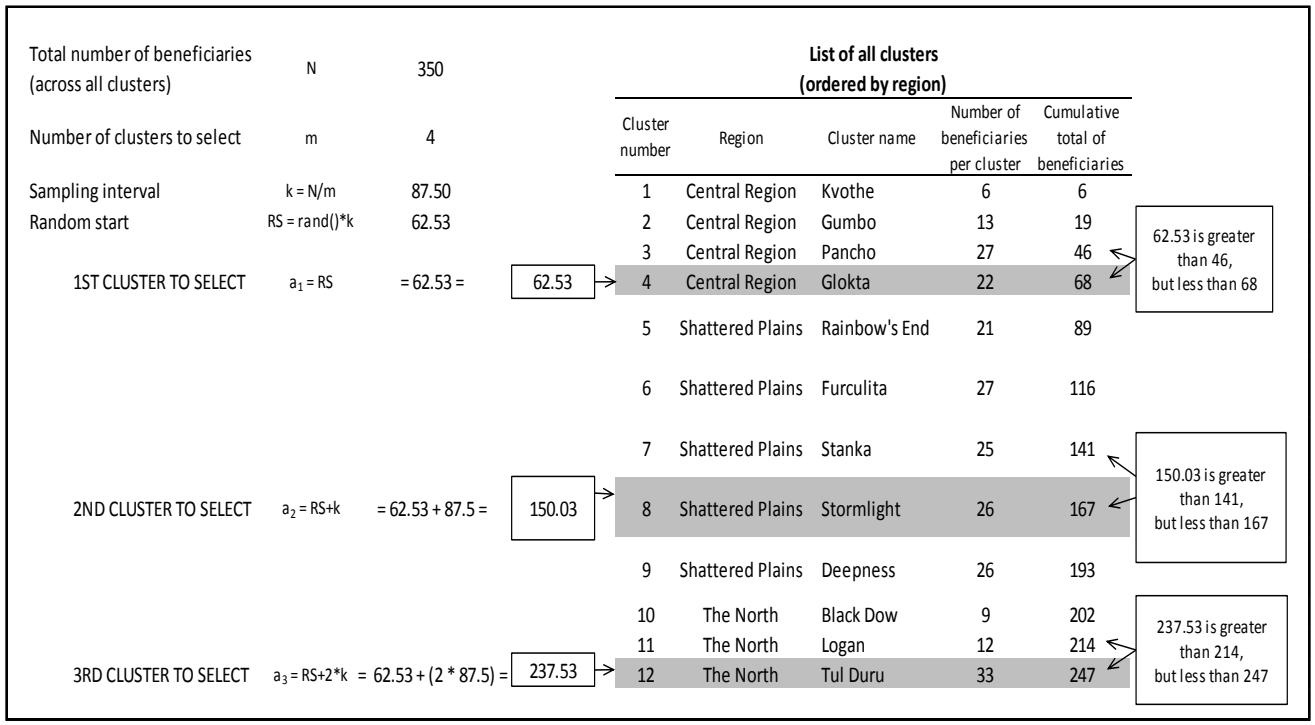
Note that if, by chance, *rand*( ) generates the number 0, then the random start is also 0. In this case, simply choose the first cluster on the list to be the first cluster in the sample.

STEP 7. Select the second cluster. Determine the second cluster to select for the sample. Compute a number a_2 that corresponds to the number obtained by adding the sampling interval (*k*) to the random start (*RS*). Identify the pair of consecutive clusters in the list for which the cumulative total corresponding to the first cluster is less than a_2 and for which the cumulative total corresponding to the second cluster is greater than or equal to a_2. Choose the second cluster in the pair. The following chart provides an example.



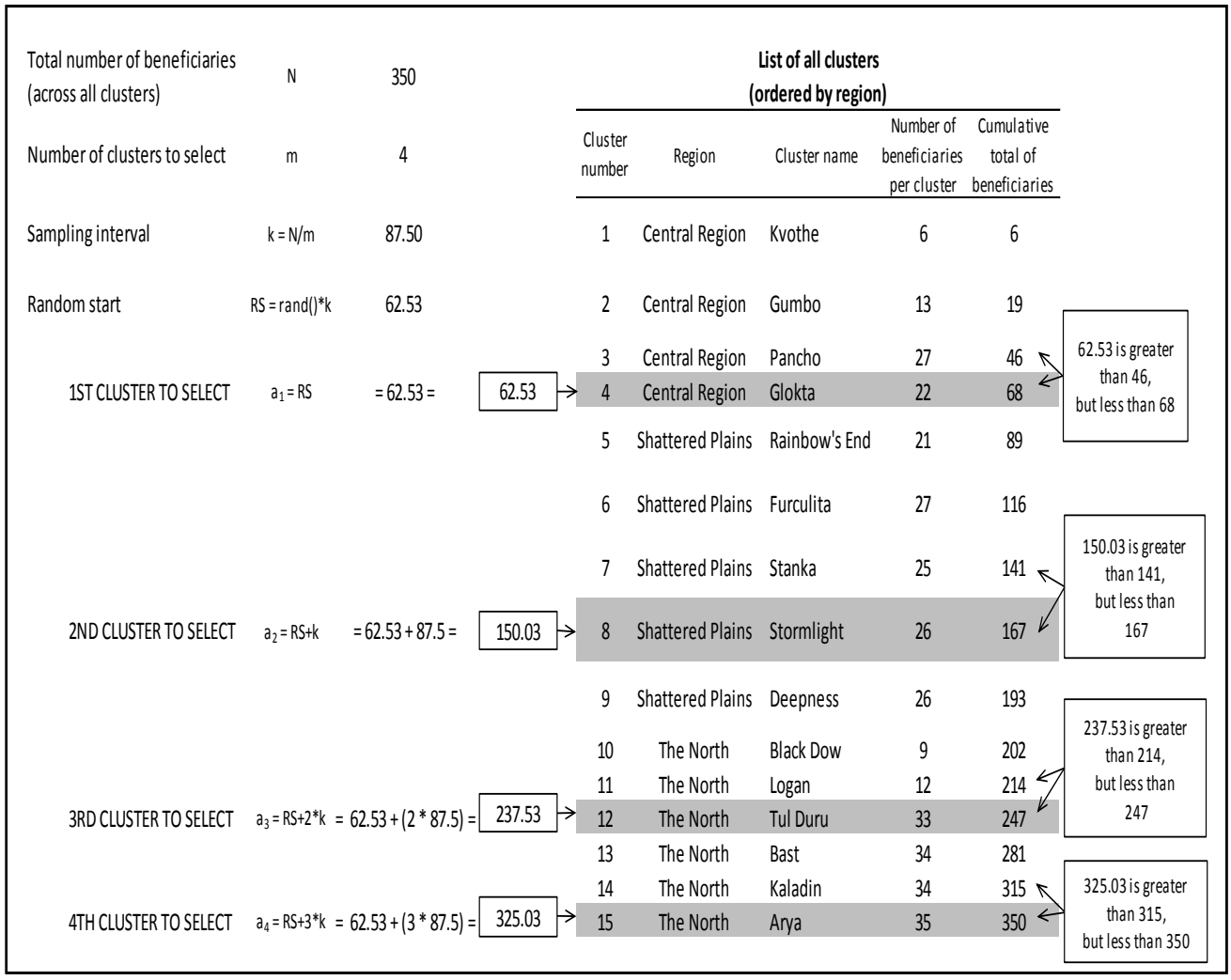
In this example, the sampling interval (k = 87.5) is added to the random start (RS = 62.53) to obtain a_2 = 150.03. Since a_2 = 150.03 is greater than 141 (corresponding to cluster 7) and less than 167 (corresponding to cluster 8), cluster 8 (Stormlight) is selected as the second cluster in the sample.

STEP 8. Select the third cluster. Create a number a_3 by adding twice the sampling interval (k) to the random start (RS) to determine the third cluster to select for the sample. Use the resultant number in exactly the same way as in Step 7 above. The following chart provides an example.



In this example, twice the sampling interval (2 * k = 2 * 87.5 = 175) is added to the random start (RS = 62.53) to obtain a_3 = 237.53. Since a_3 = 237.53 is greater than 214 (corresponding to cluster 11) and less than 247 (corresponding to cluster 12), cluster 12 (Tul Duru) is selected as the third cluster in the sample.

STEP 9. Continue in a similar fashion until the number of clusters (m) is reached. The following chart provides the final result of the selection.



In this example, three times the sampling interval (3 * k = 3 * 87.5 = 262.5) is added to the random start (RS = 62.53), resulting in 325.03. Since 325.03 is greater than 315 (corresponding to cluster 14) and less than 350 (corresponding to cluster 15), cluster 15 (Arya) is selected as the fourth and last cluster in the sample.

Also note in the example above that using implicit stratification (i.e., by ordering the clusters by region) resulted in a sample that was spread out across all regions (Central Region, Shattered Plains, and The North). As noted in Step 2, by ordering the clusters prior to sampling, it is more likely to obtain a sample of clusters with at least one cluster chosen in each region.

Finally, it is also important to note that it is possible and acceptable to select the same cluster more than once using systematic PPS sampling. This can happen if the number of beneficiaries in a particular cluster is very large and the sampling interval is relatively small (e.g., less than half the number of beneficiaries in the cluster). The treatment of this situation will be dealt with at the second stage of sampling, which is discussed in Section 9.5.4.

9.4.2 Fractional Interval Systematic Sampling

A second method of sample selection that can be used at the first stage for selection of clusters is called fractional interval systematic sampling. This method is applicable for survey design option 2 in the case where the first stage cluster frame does not contain a count of the number of farmer beneficiaries in each cluster. In this instance, it is not possible to implement systematic PPS sampling. Fractional interval systematic sampling does not use size measures, but instead assigns each cluster an equal probability of being selected.

The steps to apply fractional interval systematic sampling are similar to those used for systematic PPS sampling, although there are some nuanced differences. As with systematic PPS sampling, the steps can be carried out using any appropriate software application. By way of example, the syntax provided is what would be used in Microsoft Excel.

STEP 1. Create a list of all clusters in the project implementation area. This is essentially the first stage cluster frame described in Chapter 7, although it is not necessary to have information on the number of project beneficiaries in each cluster, as mentioned above. However, information for each cluster on the list should include the following:

- A unique ID number for the cluster
- The name of the cluster (e.g., village or community)
- The location of the cluster (census geography, GPS coordinates, etc.)
- Information on all appropriate higher-level geographic areas (e.g., province or district)

STEP 2. Order the list by a chosen geographic area. This can be done in any way, as long as all clusters in one geographic area are next to each other in the list.

STEP 3. Calculate a sampling interval. The sampling interval is calculated by dividing the total number of clusters in the project implementation area on the sampling frame (*M*) by the number of clusters to select (*m*), where the value of *m* is determined according to the instructions in Section 9.3. For instance, if *M* = 15 and *m* = 4, then the sampling interval is 3.75.

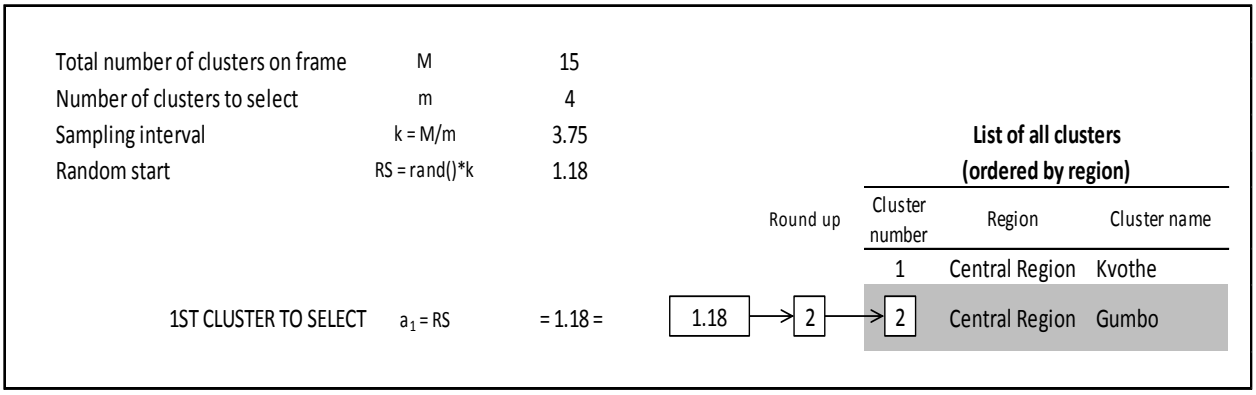
$$sampling\ interval = k = \frac{total\ number\ of\ clusters\ on\ the\ frame\ (M)}{number\ of\ clusters\ to\ select\ (m)}$$

STEP 4. Calculate a random start. The random start determines the first cluster to select. It is calculated by choosing a random number greater than or equal to 0 and less than the sampling interval. The following is the formula to use to calculate the random start using the Microsoft Excel function *rand*( ):

$$random\ start = RS = rand(\,) * sampling\ interval$$

The Excel function *rand*( ) generates a fractional random number greater than or equal to 0 and less than 1. To compute the random start (*RS*), multiply this random number by the sampling interval (*k*). For instance, if the sampling interval is *k* = 3.75 (from above) and the random number generated is *rand*( ) = 0.3146, the random start will be *RS* = 0.3146 * 3.75 = 1.18.

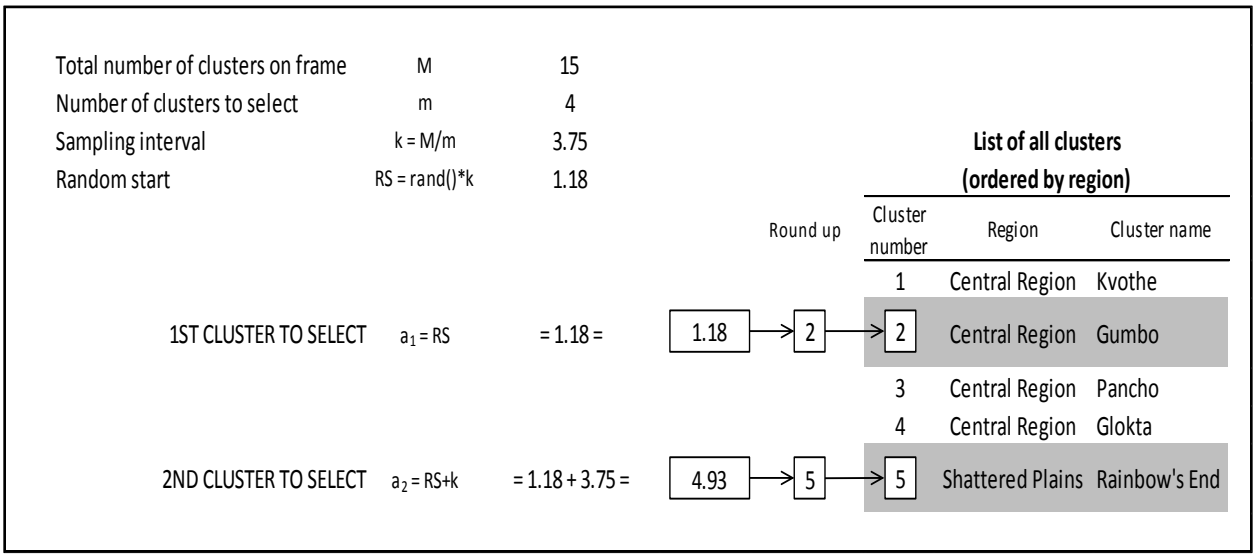
STEP 5. Select the first cluster. The first cluster to select according to this scheme will be the one whose cluster number corresponds to the random start (*RS*) rounded up to the nearest integer. The following chart provides an example.



In the example above, the random start is *RS* = 1.18 and it is rounded up to 2. Therefore, cluster 2 (Gumbo) is selected as the first cluster in the sample.

Note that if, by chance, *rand*( ) generates the number 0, then the random start is also 0. In this case, choose the first cluster on the list to be the first cluster in the sample.

STEP 6. Select the second cluster. The second cluster to select according to this scheme will be the one whose cluster number corresponds to the number formed by adding the sampling interval *k* (including integer part and all decimals) to the random start *RS* (including integer part and all decimals), rounded up to the nearest integer. The following chart provides an example.



In this example, the sampling interval (k = 3.75) is added to the random start (RS = 1.18) to obtain 4.93. This is rounded up to 5, and therefore cluster 5 (Rainbow's End) is selected as the second cluster in the sample.

STEP 7. Select the third cluster. Add twice the sampling interval (k) to the random start (RS) to determine the third cluster to select for the sample. Use the resultant number in exactly the same way as in Step 6 above. The following chart provides an example.

Total number of clusters on frame	M	15						
Number of clusters to select	m	4						
Sampling interval	k = M/m	3.75						
Random start	RS = rand()*k	1.18						
				Round up		List of all clusters (ordered by region)		
						Cluster number	Region	Cluster name
						1	Central Region	Kvothe
1ST CLUSTER TO SELECT	a_1 = RS	= 1.18 =	1.18	→ 2	→	2	Central Region	Gumbo
						3	Central Region	Pancho
						4	Central Region	Glokta
2ND CLUSTER TO SELECT	a_2 = RS+k	= 1.18 + 3.75 =	4.93	→ 5	→	5	Shattered Plains	Rainbow's End
						6	Shattered Plains	Furculita
						7	Shattered Plains	Stanka
						8	Shattered Plains	Stormlight
3RD CLUSTER TO SELECT	a_3 = RS+2*k	= 1.18 + (2 * 3.75) =	8.68	→ 9	→	9	Shattered Plains	Deepness

In this example, twice the sampling interval (2 * k = 2 * 3.75 = 7.5) is added to the random start (RS = 1.18) to obtain 8.68. This is rounded up to 9, and therefore cluster 9 (Deepness) is selected as the third cluster in the sample.

STEP 8. Continue in a similar fashion until the total number of clusters (*m*) to select is reached. The following chart provides the final result of the selection.

Total number of clusters on frame	M	15					
Number of clusters to select	m	4					
Sampling interval	k = M/m	3.75					
Random start	RS = rand()*k	1.18					
					List of all clusters (ordered by region)		
				Round up	Cluster number	Region	Cluster name
					1	Central Region	Kvothe
1ST CLUSTER TO SELECT	a_1 = RS	= 1.18 =	1.18	2	2	Central Region	Gumbo
					3	Central Region	Pancho
					4	Central Region	Glokta
2ND CLUSTER TO SELECT	a_2 = RS+k	= 1.18 + 3.75 =	4.93	5	5	Shattered Plains	Rainbow's End
					6	Shattered Plains	Furculita
					7	Shattered Plains	Stanka
					8	Shattered Plains	Stormlight
3RD CLUSTER TO SELECT	a_3 = RS+2*k	= 1.18 + (2 * 3.75) =	8.68	9	9	Shattered Plains	Deepness
					10	The North	Black Dow
					11	The North	Logan
					12	The North	Tul Duru
4TH CLUSTER TO SELECT	a_4 = RS+3*k	= 1.18 + (3 * 3.75) =	12.43	13	13	The North	Bast
					14	The North	Kaladin
					15	The North	Arya

In this example, three times the sampling interval (3 * *k* = 3 * 3.75 = 11.25) is added to the random start (*RS* = 1.18) to obtain 12.43. This is rounded up to 13, and therefore cluster 13 (Bast) is selected as the fourth and last cluster in the sample.

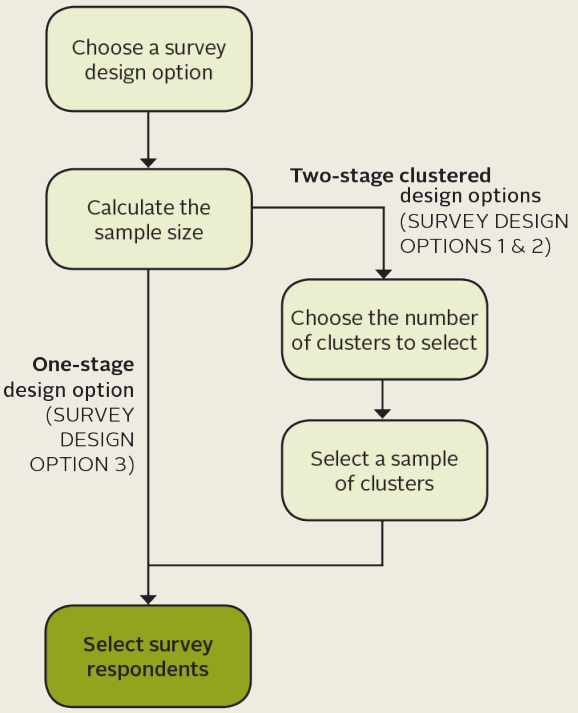
Note in the example above that, once again, using implicit stratification (i.e., by ordering the clusters by region) resulted in a sample that was spread out across all regions (Central Region, Shattered Plains, and The North), although even with ordering, it is still possible to have one or more regions with no clusters chosen.

Finally, note that with fractional interval systematic sampling, it is not possible to select the same cluster more than once, unlike with systematic PPS sampling.

9.5 Selecting the Survey Respondents for All Survey Design Options for the Household Survey Approach

The final step in the survey design process for the household survey approach is to randomly select the survey respondents to interview. The final step is relevant for all survey design options (1, 2, and 3), and it corresponds to the second stage of sampling for survey design options 1 and 2 and the first stage of sampling for survey option 3.

Figure 4e. Steps in the Approach



The process of selecting respondents is implemented by selecting beneficiaries from a list using one of two variants of an equal probability method: selecting survey respondents before fieldwork using **fractional interval systematic sampling** or selecting survey respondents in the field using **systematic sampling**. The former is appropriate for survey design options 1 and 3, while the latter is appropriate for survey design option 2.

For all three survey design options, before survey respondents can be selected using one of the two variants, a comprehensive list of beneficiaries must be constructed, whether through beneficiary registration systems before fieldwork begins (survey design options 1 and 3) or through a listing operation during fieldwork (survey design option 2).

9.5.1 Selecting Survey Respondents before Fieldwork Using Fractional Interval Systematic Sampling (for Survey Design Options 1 and 3)

Survey design option 1 entails two stages of sampling, where clusters are selected at the first stage of sampling using the methods described in Section 9.4. For the second stage of sampling of survey respondents, a comprehensive list of beneficiaries is needed from which to sample—but only for the clusters that are selected at the first stage. That means that for every cluster that is selected at the first stage, a complete list of beneficiaries in that cluster is required for the second stage of sampling before fieldwork begins.

In contrast, survey design option 3 entails only one stage of sampling, where survey respondents are directly sampled from the frame of beneficiaries, without regard to clusters. In this case, a comprehensive list of **all** beneficiaries is required before fieldwork begins. Although the selection of beneficiaries from the list is undertaken without regard to clustering, survey implementers should order the list of beneficiaries by implementation villages/communities prior to sampling, so that the systematic selection of respondents will be spread across implementation villages/communities.

Once a comprehensive list of beneficiaries is established, the next step is to randomly select beneficiaries from the sampling frame using **fractional interval systematic sampling**. This is the same method

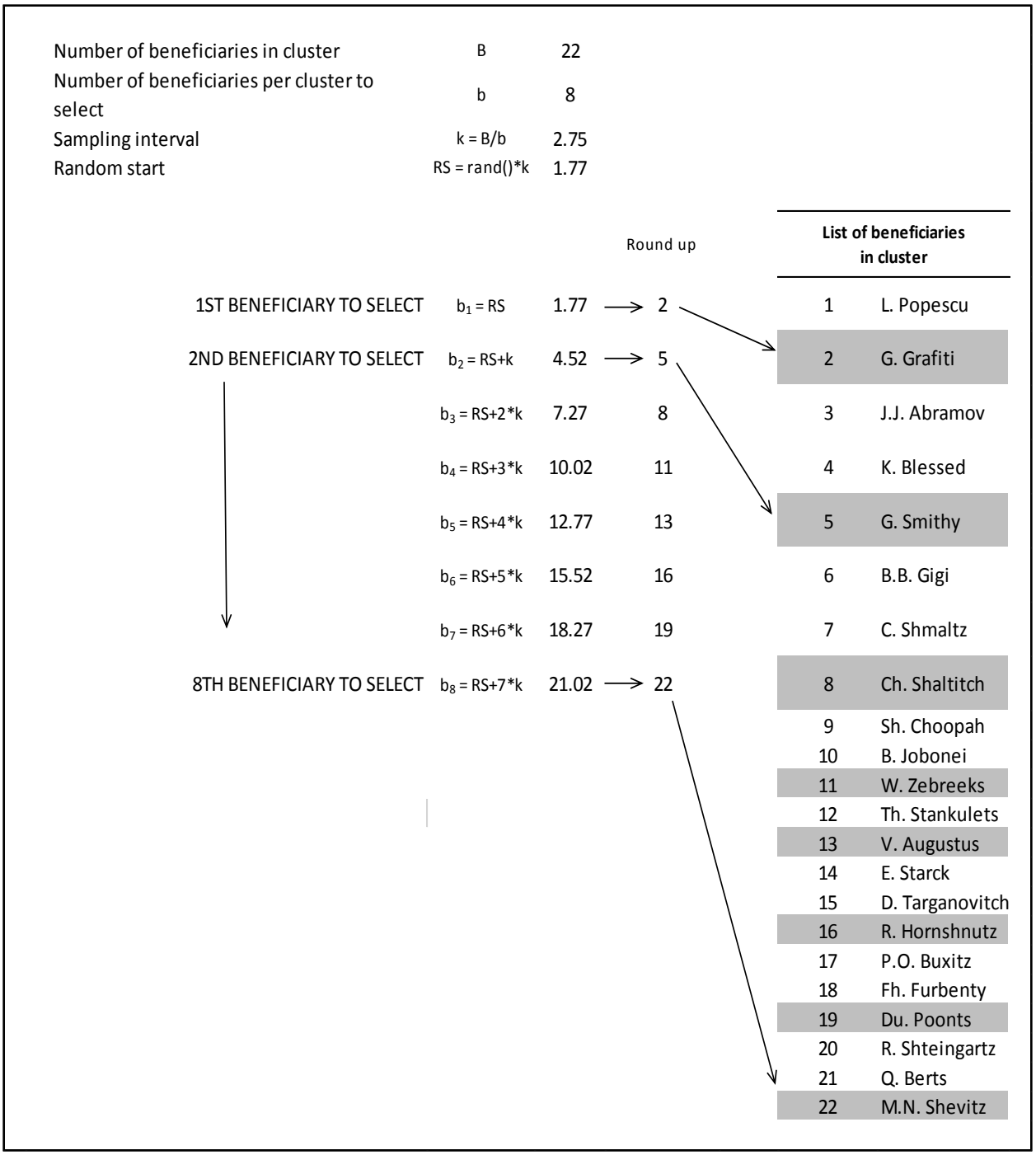
described in the previous section for the selection of clusters at the first stage of sampling. The main difference is that, at the second stage, beneficiaries rather than clusters are selected.

For survey design option 1, the same steps described in Section 9.4.2 should be followed, but using the list of project beneficiaries for each cluster and the following formula for the sampling interval:

$$sampling\ interval = k = \frac{total\ number\ of\ beneficiaries\ in\ the\ cluster\ (B)}{number\ of\ beneficiaries\ to\ sample\ in\ each\ cluster\ (b)}$$

where *b*, the number of beneficiaries to select in each cluster is determined following the instructions in Section 9.3, and *B*, the total number of beneficiaries in the cluster is determined using a count from the second stage beneficiary frame.

Note that for survey design option 1, a separate sampling interval needs to be calculated for each sampled cluster in the survey. An example of fractional interval systematic sampling for selecting from a list frame of beneficiaries assuming survey design option 1 is given on the next page.



For survey design option 3, the following formula should be used for the sampling interval:

$$sampling\ interval = k = \frac{total\ number\ of\ beneficiaries\ in\ the\ project\ (B)}{number\ of\ overall\ beneficiaries\ to\ sample\ (b)}$$

Sampling is done in a manner very similar to the example above, except selection of beneficiaries is performed across clusters, not within each sampled cluster. Therefore, only one sampling interval is required for the entire operation.

9.5.2 Listing Operation in the Field (for Survey Design Option 2)

For survey option 2, because no second stage list frame of project beneficiaries exists, the frame must be created in the field for every sampled cluster through a listing operation. After the frame is created, survey beneficiaries are then randomly selected while in the field using systematic sampling (described in the next section). This section describes the listing operation.

Listing operations occur only in the clusters randomly selected in the first stage of sampling for survey design option 2. Listing is a separate activity that takes place before survey respondents are selected and interviewing starts. In general, a listing operation is implemented by having data collectors visit every household in a cluster, stopping only at households that include project beneficiaries for the agricultural component to collect basic information on each project beneficiary in the household. If there are no project beneficiaries in a particular household, then no information is collected in that household. If there are multiple project beneficiaries in any given household, information on each of them is collected.

It is important to collect information on the location of beneficiary households within sampled clusters, so that interviewers can potentially return at a later time to conduct interviews with the beneficiaries who reside within these clusters if they are randomly selected. GPS coordinates of households can be taken and the coordinates can be recorded as part of the information on each beneficiary.

As listing progresses through the cluster, each newly identified beneficiary is added to a list, and, thus, a second stage frame of beneficiaries in each sampled cluster is dynamically created in the field. It is critical that all households in the cluster are visited to ensure that all agricultural project beneficiaries in the cluster are identified—so that the resultant list frame is as complete as possible.

The information to be included is the same as that required for the second type of sampling frame described in Chapter 7:

- Unique individual ID number
- Complete name
- Age and sex
- Household location (e.g., address or relative location, GPS coordinates)
- Village name/community name
- Location of the village/community (e.g., census geographic code or GPS coordinates, if available)
- Higher geographic levels (e.g., province or district) in which the beneficiary resides

Additional information that should be included (if feasible and affordable) is outlined in Section 7.1.

Listing operations represent additional time and expense, and, as a result, survey design option 2 is more resource intensive than survey design option 1, which does not include a listing operation. In most cases, a listing operation in a cluster lasts no more than a day or two, although this depends on the cluster size, the terrain, and any potential access issues. Given this additional burden, projects are encouraged to develop and maintain high-quality beneficiary registration systems that will help eliminate the need for the listing operations—and that will allow projects to use survey design option 1 in subsequent surveys instead.

9.5.3 Selecting Survey Respondents in the Field Using Systematic Sampling (for Survey Design Option 2)

For survey design option 2, once the listing operation has been completed, survey respondents are then selected in the field using a method called **systematic sampling**. This method is similar to fractional interval systematic sampling used for selecting beneficiaries before fieldwork described in Section 9.5.1 for survey design options 1 and 3. The main differences between the two methods are the following two simplifications:

1. The sampling interval is rounded (either up or down) to the closest integer.
2. The random start is an integer (rather than a fractional number) greater than or equal to 1 and less than or equal to the rounded sampling interval, and uses a different Microsoft Excel function from the one given for fractional interval systematic sampling.

In this case, the rounded sampling interval, $k_{rounded}$, is calculated as

$$sampling\ interval\ (rounded) = k_{rounded} = \ round(k, 0)$$

where:

$$k = \frac{total\ number\ of\ beneficiaries\ in\ the\ cluster\ (B)}{number\ of\ beneficiaries\ to\ sample\ in\ each\ cluster\ (b)}$$

and where the Microsoft Excel function *round*(*k,*0) rounds the number *k* up or down to the nearest integer.

The random start is computed as:

$$random\ start = RS = \ randbetween(1, k_{rounded})$$

where the Microsoft Excel function *randbetween*(1,$k_{rounded}$) generates a random integer (i.e., a discrete value) greater than or equal to 1 and less than or equal to $k_{rounded}$.

The above changes are made to the original fractional interval systematic sampling method in order to simplify the process of selecting beneficiaries for field staff, given that selection occurs in the field. Sampling intervals and random starts without decimals make it easier for field staff to undertake the computations required to identify the correct beneficiaries to interview.

This simplification does, however, add some uncertainty around the total number of beneficiaries that are ultimately selected for interviewing in each cluster. This is explained in more detail using the example below. Note that the example refers to sampling within one sampled cluster only. The same procedure needs to be repeated for each sampled cluster in the survey.

Number of beneficiaries in cluster		B	25		
Number of beneficiaries to select in each cluster		b	8		
Sampling interval		k = B/b	3.13		
Sampling interval (rounded)		$k_{rounded}$ = round(k,0)	3		
			Sample 1	Sample 2	Sample 3
Random start		RS = randbetween(1,$k_{rounded}$)	1	2	3
			Beneficiary number	Beneficiary number	Beneficiary number
	1ST BENEFICIARY TO SELECT	b_1 = RS	1	2	3
	2ND BENEFICIARY TO SELECT	b_2 = RS+$k_{rounded}$	4	5	6
		b_3 = RS+2*$k_{rounded}$	7	8	9
		b_4 = RS+3*$k_{rounded}$	10	11	12
		b_5 = RS+4*$k_{rounded}$	13	14	15
		b_6 = RS+5*$k_{rounded}$	16	17	18
		b_7 = RS+6*$k_{rounded}$	19	20	21
	8TH BENEFICIARY TO SELECT	b_8 = RS+7*$k_{rounded}$	22	23	24
		b_9 = RS+8*$k_{rounded}$	25		
Number of beneficiaries selected:			9	8	8

In the above example, the sampling interval $k = B \div b = 3.13$ is rounded to the nearest integer, which is $k_{rounded} = 3$. An integer random start, RS, between 1 and 3 is generated. For illustration purposes, all three possible random starts (1, 2, and 3) are shown in separate columns, as are the three different samples generated based on these random starts. The first sample consists of nine beneficiaries labeled 1, 4, 7, 10, 13, 16, 19, 22, and 25. The second sample consists of eight beneficiaries labeled 2, 5, 8, 11, 14, 17, 20, and 23. Finally, the third sample also consists of eight beneficiaries labeled 3, 6, 9, 12, 15, 18, 21, and 24. This example illustrates the fact that the actual number of beneficiaries selected through systematic

sampling in a given cluster will not always be eight, the targeted number.[42] This is due to the rounding of the sampling interval that is used as a simplification to the more standard fractional interval systematic sampling.

In the case of Sample 1 above where nine beneficiaries are selected instead of the targeted eight, it is important to interview all nine beneficiaries and not stop after eight interviews. Stopping short will result in a sample where some of the beneficiaries have a zero probability of being selected. In probability-based sampling, all selection units must have a non-zero probability of being selected.

Note that if the number of beneficiaries to be selected in the cluster equals to or exceeds the number of beneficiaries in the cluster (i.e., $b \geq B$), then there is no need to undertake the above computation, and in this case, all beneficiaries in the cluster should be selected even though there may be a shortfall in the sample size for that cluster.

9.5.4 Considerations to Take into Account When Selecting the Survey Respondent

1. For both fractional interval systematic sampling and systematic sampling, there should be no substitutions of sampled beneficiaries with replacement beneficiaries when collecting data in the field. For example, if the first sample is chosen in the example above using systematic sampling, then beneficiaries 1, 4, 7, 10, 13, 16, 19, 22, and 25 must be located (using the information from the second stage beneficiary frame) and must be interviewed. If a selected beneficiary is not present or chooses not to respond, survey implementers should not visit one of the other beneficiaries on the sampling frame that was not part of the selected sample as a substitute. If a beneficiary is not available for interviewing, the data collector should revisit the household up to three times to secure an interview. If, after three attempts, an interview still cannot be secured, then the beneficiary should be labeled as a "non-respondent" and sample weight adjustments must be made after fieldwork to compensate for the data relating to the missing respondent. Recall that when the sample size was calculated, the initial sample size was inflated to compensate for anticipated non-response, i.e., to compensate for the fact that not all interviews in the field would be secured as planned.
2. For systematic sampling only, it is possible that the total number of survey respondents will not be achieved, and that more (or fewer) beneficiaries will be interviewed in the survey than originally planned. This is illustrated in the example above, where eight beneficiaries were targeted for interviewing in a particular sampled cluster, but nine were ultimately selected in sample 1 for that cluster. On average, the total sample size target for the survey across all sampled clusters will be met (barring individual non-response), but in some clusters the exact sample size target may not be met.
3. It was previously noted that when using systematic PPS sampling at the first stage of sampling, it is possible to select the same cluster more than once. Although this is rare, when this happens, the two (or more) selections of the same sampled cluster should be treated separately. In this case, at the

[42] Note that in the above example, one of the three possible samples produces more than the target number of sampled beneficiaries per cluster (i.e., 9 instead of 8). However, there are also examples where some samples produce fewer than the target number of sampled beneficiaries. For example, if $B = 25$, $b = 9$, then $k_{rounded} = 3$. In this case, there are three possible samples, but only one of them will have nine beneficiaries selected; the other two will have eight beneficiaries selected.

second stage of sampling, the treatment within sampled clusters depends on which method is used at the second stage of sampling: fractional interval systematic sampling or systematic sampling.

When the same cluster is selected twice at the first stage of sampling and fractional interval systematic sampling is used at the second stage of sampling, the list of beneficiaries in the cluster should be divided in two equal parts, and separate sampling using fractional interval systematic sampling should take place in each half of the cluster. This is to ensure that there will not be any overlap in the two samples of beneficiaries within the same sampled cluster.

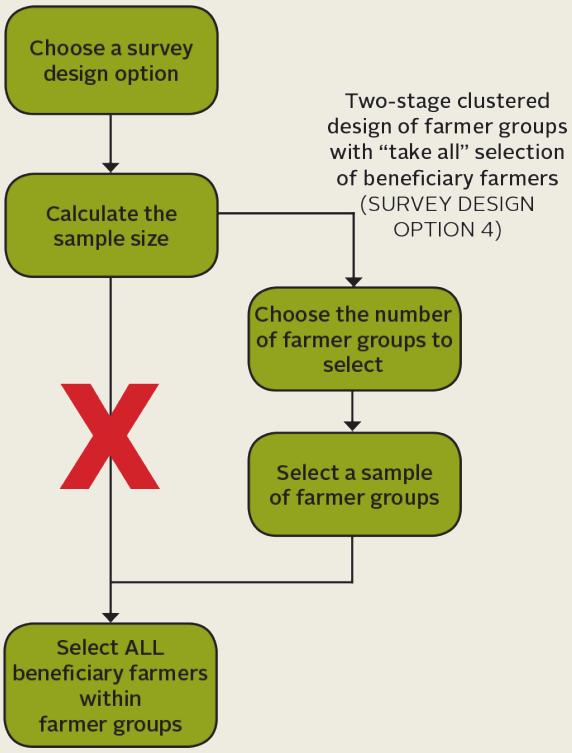
When the same cluster is selected twice at the first stage of sampling and systematic sampling is used at the second stage of sampling, two distinct random starts should be chosen for the sampled cluster, and, on this basis, two distinct samples of beneficiaries will be chosen from within the same cluster. The use of two distinct random starts ensures that the two samples of beneficiaries within the same sampled cluster will not overlap. Note by way of illustration that in the above example, samples 1, 2, and 3 are distinct samples with no overlap of beneficiaries.

CHAPTER

10. The Farmer Groups Approach (Approach 2)

This chapter provides details on how to implement the FGs approach. This approach uses the same survey design steps as the household survey approach, that is to say: choose a survey design option (although there is only one option for this approach), calculate the sample size, choose the number of clusters (FGs) to select, select a sample of clusters (FGs), and select the survey respondents. The specifics of each of these steps are described in the following sections.

Figure 4f. Steps in the Approach



10.1 Choose a Survey Design Option

For the FGs approach, a new survey design option is used.

- **Survey design option 4:** Two-stage cluster design of FGs, with "take all" selection of beneficiaries within sampled FGs at the second stage of sampling.

One basic difference between this survey design option and any of the three survey design options discussed under the household survey approach is that FGs rather than villages/communities constitute clusters, and the surveys take place at the same time as project implementation with the FGs. Another difference is that "take all" selection of beneficiaries, rather than a sample selection of beneficiaries, is used at the second stage of sampling.

At the first stage, a sample of FGs (clusters) is selected from the first stage frame of all FGs using **fractional interval systematic sampling**. After FGs are selected from the sampling frame, the sampled FGs are visited during the next FG meeting. At the second stage, a comprehensive list of all beneficiary farmers within the selected FGs is used to ensure that all beneficiary farmers have a chance to be interviewed. Any farmers who are absent from the FG meeting are treated as non-respondents and sample weight adjustments are made to compensate for the missing data. See Chapter 11 for more details.

10.2 Calculate the Sample Size and Choose the Number of Farmer Groups to Select

For the FGs approach, the overall number of beneficiaries to sample in the survey, n_{final}, is calculated the same way that it is in the household survey approach described in Section 9.2.

To determine the number of clusters to select, the same approach is followed as was used in Section 9.3. However, because clusters are FGs (rather than villages or communities) and because *b*, the number of beneficiaries per FG, tends to fall in the 15–30 range for Feed the Future IPs, it is not necessary to calculate minimum and maximum values for *b*. The exploratory work undertaken by the Food and Nutrition Technical Assistance Project (FANTA) prior to drafting this guide revealed that most projects tend to choose a roughly fixed size for their FGs (e.g., 20), and therefore, when using FGs as clusters, *b* is roughly constant. As a result, the following formula can be used to determine the number of FGs to select based on n_{final} and the roughly constant value for *b*:

$$m = round(\frac{n_{final}}{b})$$

10.3 Select a Sample of Farmer Groups

The next step in the survey design process is to randomly select a sample of clusters, which in this case are FGs, from the sampling frame of all the FGs in which the agricultural project is implemented. Note that it is important for survey implementers who wish to use the FGs approach to maintain a complete and comprehensive list frame of active FGs from which to sample at the first stage.

To select a sample of FGs, survey implementers should use **fractional interval systematic sampling**, as described in Section 9.4.2, rather than systematic PPS sampling. This is because most FGs are of approximately the same size, and therefore there is little benefit to using systematic PPS sampling. Recall that for systematic PPS sampling, clusters with a greater number of project beneficiaries have a greater chance of being selected from the frame, while clusters with fewer number of project beneficiaries have a smaller chance of being selected from the frame. Therefore, survey implementers should use systematic PPS sampling if FG sizes vary widely.

10.4 Select All Beneficiary Farmers

The final step in the survey design process for the FGs approach is to select the survey respondents. It is key that survey implementers maintain a complete and comprehensive second stage frame of all beneficiaries within all active FGs. Because there is only a small number of farmers in a typical FG (typically 15–35 farmers), the recommendation is to interview all beneficiary farmers in a sampled FG. This approach is called **"take all" sampling**. If some of the farmers within a sampled FG do not participate in a FG meeting where data are being collected, a sample weight adjustment for beneficiary non-response should be made to compensate. See Chapter 11 for more details.

Note that, under the FGs approach, it is important to interview selected farmers individually rather than in a group. Group interviews could induce response biases stemming from the propensity toward social desirability outcomes and potential competition between farmers. In addition, because of the sensitivity of the data collected (i.e., value of sales, quantity of sales, value of purchased cash inputs, etc.), group reporting could be considered an infringement of individual confidentiality protection. However, interviewing 15–35 farmers in a farmer group during one session can be time consuming for farmers, particularly if they are interviewed individually, given the need for each farmer to "wait for his or her turn." One potential way of minimizing the waiting time for farmers is to establish a dedicated FG meeting for the sole purpose of data collection and to ensure that there are sufficient interviewers so

that the ratio of farmers to interviewers is no more than 3 or 4 to 1. Another potential way to mitigate this problem is to introduce a second stage of sampling within each selected FG so that only a subset of the 15–35 farmers in a given FG is interviewed. However, this means that additional FGs need to be sampled at the first stage to maintain the original sample size. This solution is complex to implement in the field and so should be considered only as a last resort solution.

One of the potential disadvantages to the FGs approach (assuming a "take all" sampling approach) is that the final sample size may deviate somewhat from the target sample size because the approach is dependent on the participation of **all** beneficiary farmers for the selected FG meeting(s) where data are collected. However, if attendance at FG meetings is known to be low, it is still possible to safeguard against a shortfall in the sample size. To do so, one can use a larger adjustment for anticipated individual non-response when computing the sample size. See Section 9.2.3 for more details. Another disadvantage to this approach is the potential for bias in the results, because farmers who attend FG meetings may be more likely to apply new technologies or may be more likely to have higher gross margin values than those farmers who do not attend FG meetings.

PART 6

DATA ANALYSIS: SAMPLE WEIGHTING AND THE CONSTRUCTION OF INDICATOR ESTIMATES AND THEIR CONFIDENCE INTERVALS AND STANDARD ERRORS

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CHAPTER

11. Sample Weighting

After data collection is completed, there are a number of post-fieldwork activities that typically take place prior to and in support of data analysis. First, the data are entered or uploaded into a database. If paper questionnaires have been used, then typically double data entry[43] is used to help minimize errors in data entry. The data are then "cleaned." This usually means that the data entry software has been designed to allow only valid data ranges (e.g., beneficiary farmer ages must be between 15 and 80 years), to check that questionnaire logic has been adhered to (e.g., skips and filters respected), and to flag for resolution any logical inconsistencies in the data (e.g., a 4-year-old beneficiary farmer). After data cleaning, a check is typically performed to make sure that there are no "outlier" values (e.g., a smallholder farmer with sales of US$1,000,000). Sampling weights are then constructed to reflect the various stages of sampling. A sampling weight is attached to each of the respondents on the cleaned data file. Finally data analysis, which includes the production of estimates of the annual monitoring indicators and their associated confidence intervals and standard errors, takes place.

This chapter and the next two address the last three topics of: sample weighting, producing estimates of indicators, and producing confidence intervals and standard errors associated with the indicators.

The first step to take before data analysis is to calculate the sample weights associated with each of the beneficiaries who have been randomly selected in the BBS and who have responded to the survey interview questions. Sample weights for each selected beneficiary are calculated and applied to corresponding individual survey data record(s) to inflate the beneficiary data values up to the level of the population of beneficiaries. In essence, sample weights are a means of compensating for having collected data on a sampled subset of the beneficiary population, instead of having conducted a full "census" of all the project beneficiaries.

For the survey design options discussed in earlier chapters, sample weights should be calculated and used in the construction of estimates of each indicator to account and compensate for the following:

- Probabilities of selection at each stage of sampling
- Non-response at the individual beneficiary level

11.1 Calculating Sample Weights to Reflect Probabilities of Selection

All beneficiaries included on a sampling frame have an underlying chance or probability of being included in the sample. For example, if 1 beneficiary is randomly selected from among 10 possible beneficiaries on a sampling frame, the probability of that respondent being selected is 1 in 10 and the associated sampling weight is 10. One interpretation of a sample weight is that the selected beneficiary represents all 10 beneficiaries—himself or herself, along with the 9 other beneficiaries who were not

[43] Double data entry is a data entry quality control method, where, in the first pass through a set of records, an operator enters data from all records. On the second pass through the batch, a verifier enters the same data. The contents entered by the verifier are compared with those of the original operator. If there are differences, the data fields or records where there are differences are flagged for follow-up and reconciliation.

selected in the survey. The individual sample weight of each respondent is multiplied by each value of the respondent's data before the quantity is summed across all respondent beneficiaries to form an estimate of a total. When the survey data on beneficiaries are used to make inferences about the entire beneficiary population, the survey weighted data from the beneficiary used in the example above will have the effect of "being replicated" 10 times.

11.1.1 Overview of How to Calculate Sample Weights to Account for Probabilities of Selection

For survey design options 1, 2, and 4, where there are two stages of sampling, the sampling weight associated with the probabilities of selection for each sampled beneficiary is calculated (in general terms) using the steps outlined below. The specifics of the general set of steps in relation to each of the survey design options will be mapped out in the sections that follow.

STEP 1. Calculate the probability of selection at the first stage of selection (this corresponds to the selection of clusters, i.e., villages, communities, or FGs). This is done for each cluster.

$$probability\ of\ selection\ of\ cluster\ i\ at\ the\ first\ stage = f_{1i}$$

STEP 2. Calculate the probability of selection at the second stage of selection (this corresponds to the "conditional" selection of survey beneficiaries, assuming that the cluster in which the beneficiary resides has been selected at the first stage of sampling). This is done for each beneficiary who has been randomly selected for inclusion in the sample, regardless of whether or not he or she has responded. It is important to keep track of all survey beneficiaries who have been selected for inclusion in the sample at this stage; an adjustment for the non-responding beneficiaries in the sample is made later.

$$probability\ of\ selection\ of\ beneficiary\ j\ at\ the\ second\ stage, assuming\ cluster\ i\ selected\ at\ first\ stage = f_{2ij}$$

STEP 3. To calculate the overall probability of selection for each beneficiary selected for inclusion in the sample, f_{ij}, multiply the probability of selection at the first stage (for the cluster from which the beneficiary was selected) by the conditional probability of selection of the beneficiary at the second stage.

$$f_{ij} = f_{1i} * f_{2ij}$$

STEP 4. To calculate the overall sample weight that reflects the probabilities of selection at each stage, take the inverse of the quantity calculated in step 3:

$$overall\ sample\ weight = w_{ij} = \frac{1}{f_{ij}} = \frac{1}{f_{1i} * f_{2ij}}$$

For survey design option 3, there is only one stage of selection and it corresponds to a single stage of selection of beneficiary *j*:

$$overall\ sample\ weight = w_j = \frac{1}{f_j}$$

Note that for survey design option 3, $w_{ij} = w_j$ and $\frac{1}{f_{ij}} = \frac{1}{f_j}$. This is because there is no stage of sampling for clusters, and therefore the subscript *i* is dropped from the notation.

For survey design option 3, although all of the sample weights are identical given that all sampled beneficiaries are selected with the same (equal) probability, it is still necessary to compute and use the sample weight in the associated analyses. This is because most of the indicators to be estimated for annual monitoring are totals (rather than proportions), and therefore the sample-weighted estimates of the totals must be appropriately inflated to reflect all beneficiaries in the population.

Lastly, for all survey design options (1–4), a non-response adjustment needs to be made to the overall sampling weight to compensate for the selected beneficiaries who did not respond to the survey. More details on this will be given in the sections that follow.

The previous section provides general formulas for computing sample weights at each stage of sampling. In the following sections, specific formulas will be provided for each of the four survey design options that are used in this guide. **Table 5** provides a summary of the types of sampling recommended for each of the four survey design options at each stage of sampling. See Sections 9.1 and 10.1 for more details.

Table 5. Summary of Types of Sampling for Each of the Survey Design Options

	Survey design option 1	Survey design option 2	Survey design option 3	Survey design option 4
Sampling of clusters (at first stage)	Systematic PPS	Systematic PPS or fractional interval systematic	Not applicable	Fractional interval systematic
Sampling of beneficiaries (at first or second stage)	Fractional interval systematic	Systematic	Fractional interval systematic	Take all

11.1.2 Calculating the Probability of Selection at the First Stage

For survey design options 1, 2, and 4 (the options where clustering is used), the probability of selection at the first stage, that is, the probability of selection of clusters, is calculated differently depending on which of the selection methods is used—systematic PPS sampling or fractional interval systematic sampling.

When **systematic PPS sampling** is used at the first stage of sampling (survey design option 1 or 2), the probability of selection of the *ith* cluster is calculated as follows:

$$f_{1i} = \frac{(number\ of\ clusters\ to\ be\ selected * total\ number\ of\ beneficiaries\ in\ selected\ cluster\ i)}{total\ number\ of\ beneficiaries\ in\ all\ clusters}$$

$$= \frac{m * B_i}{N}$$

In the above formula, m is the number of clusters selected (computed in Section 9.3) and B_i is the total number of beneficiaries in selected cluster i (computed through a count from the sampling frame). The following illustrates the calculation of the probabilities of selection for systematic PPS sampling, continuing the example from Section 9.4.1:

Total number of beneficiaries	N	350	
Number of clusters to select	m	4	
Sampling interval	$k = N/m$	87.50	
Random start	$RS = rand()*k$	62.53	

Cluster number	Region	Cluster name	B_i Number of beneficiaries in each cluster	Cumulative total of beneficiaries	$f_{1i} = (m*B_i) / N$ Probability of selection (first stage)	
1	Central Region	Kvothe	6	6		
2	Central Region	Gumbo	13	19		
3	Central Region	Pancho	27	46		
4	Central Region	Glokta	22	68	0.2514	*= (4 * 22) / 350*
5	Shattered Plains	Rainbow's End	21	89		
6	Shattered Plains	Furculita	27	116		
7	Shattered Plains	Stanka	25	141		
8	Shattered Plains	Stormlight	26	167	0.2971	*= (4 * 26) / 350*
9	Shattered Plains	Deepness	26	193		
10	The North	Black Dow	9	202		
11	The North	Logan	12	214		
12	The North	Tul Duru	33	247	0.3771	*= (4 * 33) / 350*
13	The North	Bast	34	281		
14	The North	Kaladin	34	315		
15	The North	Arya	35	350	0.4000	*= (4 * 35) / 350*
			350			

When **fractional interval systematic sampling** is used at the first stage of sampling (survey design options 2 or 4), the probability of selection of the *ith* cluster is calculated as follows:

$$f_{1i} = \frac{number\ of\ clusters\ or\ FGs\ to\ be\ selected}{total\ number\ of\ clusters\ or\ FGs\ on\ frame} = \frac{m}{M}$$

Note that in this case, the probability of selection is the same for all clusters and so does not depend on which cluster it is (i.e., on *i*.) The following example illustrates the calculation of the probabilities of selection for fractional interval systematic sampling, continuing the example from Section 9.4.2.

Total number of clusters on frame	*M*	15
Number of clusters to select	*m*	4
Sampling interval	*k = M/m*	3.75
Random start	*RS = rand()*k*	1.18

Cluster number	Region	Cluster name	$f_{1i} = m / M$ Probability of selection (first stage)	
1	Central Region	Kvothe		
2	Central Region	Gumbo	0.2667	*= 4 / 15*
3	Central Region	Pancho		
4	Central Region	Glokta		
5	Shattered Plains	Rainbow's End	0.2667	*= 4 / 15*
6	Shattered Plains	Furculita		
7	Shattered Plains	Stanka		
8	Shattered Plains	Stormlight		
9	Shattered Plains	Deepness	0.2667	*= 4 / 15*
10	The North	Black Dow		
11	The North	Logan		
12	The North	Tul Duru		
13	The North	Bast	0.2667	*= 4 / 15*
14	The North	Kaladin		
15	The North	Arya		

11.1.3 Calculating the Probability of Selection at the Second Stage

The three methods used for selecting beneficiaries at the second stage are **fractional interval systematic sampling** (for survey design option 1 or 3), **systematic sampling** (for survey design option 2), and **take all sampling** (for survey design option 4). For the first two methods, the formula to use to calculate the conditional probability of selection for the *jth* beneficiary in cluster *i* at the second stage is the following[44]:

$$f_{2ij} = \frac{total\ number\ of\ beneficiaries\ selected\ for\ sampling\ in\ cluster\ i}{total\ number\ of\ beneficiaries\ in\ cluster\ i} = \frac{b_i}{B_i}$$

For **take all sampling**, because the number of beneficiaries selected for sampling in any cluster is always the same as the number of beneficiaries in that cluster, f_{2ij} always equals 1.

In the above formula, b_i is the total number of beneficiaries to be selected in cluster *i*, as computed in Section 9.3. The value for b_i is not always the same for all selected clusters (particularly with systematic sampling) and therefore the value of b_i depends on *i*. For instance, in the illustrative example in Section 9.5.3 where survey respondents in the field are selected using systematic sampling under survey design

[44] Strictly speaking, for the systematic sampling variant, the denominator should include a small adjustment due to the rounding of the sampling interval, but this can be ignored for simplicity sake because it makes very little difference to the overall probability.

option 2, different samples 1, 2, and 3 result in somewhat different values for b_i. In contrast, the value of B_i, the total number of beneficiaries in cluster *i*, will rarely be the same for all selected clusters, and therefore the value of B_i again depends on *i*.

The calculation of the probabilities of selection at the second stage is illustrated below, continuing the example from Section 9.5.1 where fractional interval systematic sampling is used at the second stage of sampling.

Number of beneficiaries in cluster i	B_i	22
Number of beneficiaries to select in cluster i	b_i	8
Sampling interval	$k = B_i/b_i$	2.75
Random start	$RS = rand()*k$	1.77

Beneficiary number	Beneficiary name	$f_{2ij} = b_i / B_i$ Probability of selection (second stage)	
1	L. Popescu		
2	G. Grafiti	0.3636	= 8 / 22
3	J.J. Abramov		
4	K. Blessed		
5	G. Smithy	0.3636	= 8 / 22
6	B.B. Gigi		
7	C. Shmaltz		
8	Ch. Shaltitch	0.3636	= 8 / 22
9	Sh. Choopah		
10	B. Jobonei		
11	W. Zebreeks	0.3636	= 8 / 22
12	Th. Stankulets		
13	V. Augustus	0.3636	= 8 / 22
14	E. Starck		
15	D. Targanovitch		
16	R. Hornshnutz	0.3636	= 8 / 22
17	P.O. Buxitz		
18	Fh. Furbenty		
19	Du. Poonts	0.3636	= 8 / 22
20	R. Shteingartz		
21	Q. Berts		
22	M.N. Shevitz	0.3636	= 8 / 22

An example of systematic sampling at the second stage of sampling is not provided here, but the calculation would be similar to that in the example given above.

11.1.4 Calculating the Overall Probability of Selection

Once the probability of selection at the first and second stages of sampling is calculated, the overall probability of selection for a beneficiary in the sample can be calculated by multiplying the probability of selection at the first stage by the probability of selection at the second stage.

$$f_{ij} = f_{1i} * f_{2ij}$$

When **systematic PPS sampling** is used in the first stage (survey design option 1 or 2), and either **fractional interval systematic sampling** (survey design option 1 only) or **systematic sampling** (survey design option 2 only) is used at the second stage (see Table 5), the formula for the overall probability of selection for a beneficiary *j* in cluster *i* is the following:

$$f_{ij} = f_{1i} * f_{2ij} = \left(\frac{m * B_i}{N}\right) * \left(\frac{b_i}{B_i}\right) = \frac{m * b_i}{N}$$

The following illustrates the calculation of the overall probabilities of selection, continuing the examples above where systematic PPS sampling is used at the first stage of sampling and fractional interval systematic sampling is used at the second stage of sampling (survey design option 1). The calculation is performed for one of the sampled first stage clusters (Glokta) only:

Number of clusters selected	m	4
Total number of beneficiaries	N	350
Number of beneficiaries in cluster i	B_i	22
Number of beneficiaries to select in cluster i	b_i	8

				$f_{1i} = (m*B_i) / N$			$f_{2ij} = b_i / B_i$	$f_{ij} = f_{1i} * f_{2ij}$
Cluster number	Region	Cluster name	Number of beneficiaries	Probability of selection (first stage)	Beneficiary number	Beneficiary name	Probability of selection (second stage)	Probability of selection (overall)
4	Central Region	Glokta	22	0.2514	2	G. Grafiti	0.3636	0.0914
					5	G. Smithy	0.3636	0.0914
					8	Ch. Shaltitch	0.3636	0.0914
					11	W. Zebreeks	0.3636	0.0914
					13	V. Augustus	0.3636	0.0914
					16	R. Hornshnutz	0.3636	0.0914
					19	Du. Poonts	0.3636	0.0914
					22	M.N. Shevitz	0.3636	0.0914

When **fractional interval systematic sampling** is used in the first stage, and **systematic sampling** is used at the second stage (survey design option 2 only; see Table 5), the formula for the overall probability of selection is the following:

$$f_{ij} = f_{1i} * f_{2ij} = \left(\frac{m}{M}\right) * \left(\frac{b_i}{B_i}\right)$$

For design option 3, when **fractional interval systematic sampling** is used to select beneficiaries directly (the only stage of sampling; see Table 5), the formula for the overall probability of selection for beneficiary *j* is the following:

$$f_j = \frac{b}{B}$$

In this case, since there are no clusters, neither *B* nor *b* depends on *i,* and therefore, both are constants.

For design option 4, when **fractional interval systematic sampling** is used at the first stage of sampling and a **take all** strategy is used at the second stage of sampling (see Table 5), the formula for the overall probability of selection is the following:

$$f_{ij} = \frac{m}{M}$$

11.1.5 Calculating the Sampling Weights to Account for Probabilities of Selection

At the final step, the sampling weights to account for the probabilities of selection are calculated by taking the inverse of the total probability of selection. For survey design options 1, 2, and 4, the formula is given by:

$$w_{ProbSelection} = w_{ij} = \frac{1}{f_{ij}} = \frac{1}{f_{1i} * f_{2ij}}$$

For survey design option 3, the formula is given by:

$$w_{ProbSelection} = w_j = \frac{1}{f_j}$$

The following illustration demonstrates the computation of the sample weights, continuing the example above where **systematic PPS sampling** is used at the first stage of sampling and **fractional interval systematic sampling** is used at the second stage of sampling (survey design option 1):

Number of clusters selected	m	4
Total number of beneficiaries	N	350
Number of beneficiaries in cluster i	B_i	22
Number of beneficiaries to select in cluster i	b_i	8

				$f_{1i} = (m*B_i)/N$			$f_{2ij} = b_i / B_i$	$f_{ij} = f_{1i} * f_{2ij}$	$w = 1/f_{ij}$
Cluster number	Region	Cluster name	Number of beneficiaries	Probability of selection (first stage)	Beneficiary number	Beneficiary name	Probability of selection (second stage)	Probability of selection (overall)	Sampling weight
4	Central Region	Glokta	22	0.2514	2	G. Grafiti	0.3636	0.0914	10.94
					5	G. Smithy	0.3636	0.0914	10.94
					8	Ch. Shaltitch	0.3636	0.0914	10.94
					11	W. Zebreeks	0.3636	0.0914	10.94
					13	V. Augustus	0.3636	0.0914	10.94
					16	R. Hornshnutz	0.3636	0.0914	10.94
					19	Du. Poonts	0.3636	0.0914	10.94
					22	M.N. Shevitz	0.3636	0.0914	10.94

11.2 Adjusting Survey Weights for Non-Response

It is to be expected that some percentage of beneficiaries randomly selected for the survey will be unreachable, unavailable, or unwilling to respond to any or all of the survey questions; this is called "individual non-response." The recommended survey protocol is that interviewers return to households up to three times to complete an interview with the selected beneficiaries who reside within. Despite the best efforts of interviewers, however, there is always some residual non-response that remains even after three attempts to complete an interview with the respondent. When non-response happens, adjustments to the sample weights need to be applied to compensate for the non-response.[45]

To calculate the weight adjustments for non-response, the survey must track both the selected beneficiaries who do not respond and the selected beneficiaries who do respond. Both respondents and non-respondent have probabilities of selection. But since no interview has taken place for the non-responding selected beneficiaries, the sample weights of the responding selected beneficiaries are inflated to compensate for those who did not respond.

The weight adjustment for non-response for survey design options 1, 2, and 4 is calculated as:

$$w_{non-response} = \frac{number\ of\ beneficiaries\ selected\ to\ be\ interviewed\ (in\ a\ sampled\ cluster)}{number\ of\ beneficiaries\ actually\ interviewed\ (in\ a\ sampled\ cluster)}$$

For survey design options 1, 2, and 4, a weight adjustment for non-response should be calculated individually for each sampled cluster. The weight adjustments for non-response will vary among clusters given that clusters will likely experience different non-response rates. However, for all survey respondents in a particular sampled cluster, the same weight adjustment for non-response can be used. After the weight adjustment is made, the records for the non-responding sampled beneficiaries can then be dropped for the purposes of analysis.

For survey design option 3, a similar adjustment to the one above is made, but at the overall level instead of for each individual sampled cluster.

The following illustrates this, continuing the above example where clustering is involved:

[45] Note that sometimes a sampled individual may provide data, but only for some of the indicators and not for others. In this case, the individual is deemed a "partial respondent" and the missing data points are called "item non-responses." Sometimes the missing data points for the individual are "imputed" using special statistical methods. However, if the number of missing data points is not large, a common practice is to leave the missing data points blank and to compute the indicators without the inputs from the missing respondent(s). Since a discussion on methods of imputation is beyond the scope of this guide, it is assumed that the latter strategy will be adopted for implementers of BBSs.

Number of beneficiaries in cluster i	B_i	22	
Number of beneficiaries selected to be interviewed in cluster i	b_i	8	
Number of beneficiaries who do not respond (not found, not present or who refuse)	NR	1	
Number of beneficiaries interviewed	$b_i - NR$	7	
Weight adjustment to compensate for nonresponse	$w_{non\text{-}response}$	1.143	$= 8 / 7$

11.3 Calculating the Final Sampling Weights

For all four survey design options, the final sample weights to be used in all data analysis are calculated by multiplying the sample weights (inverse of the probabilities of selection) by the weight adjustment for non-response:

$$w_{final} = w_{ProbSelection} * w_{non-response}$$

The illustration below demonstrates this computation, using the example above where systematic PPS sampling is used at the first stage of sampling and fractional interval systematic sampling is used at the second stage of sampling (survey design option 1). In this example, of the eight beneficiaries selected for sampling, one does not respond (beneficiary #5, G. Smithy), and the non-respondent record is dropped. After the non-response adjustment is made, the resulting final sample weight is applied to each responding beneficiary who was sampled and used in the analysis of the data.

Number of clusters selected	m	4
Total number of beneficiaries	N	350
Number of beneficiaries in cluster i	B_i	22
Number of beneficiaries selected in cluster i	b_i	8
Number of beneficiaries who did not respond in cluster i	NR	1
Number of beneficiaries interviewed in cluster i	$b_i - NR$	7

				$f_{1i} = (m*B_i)/N$			$f_{2ij} = b_i/B_i$	$f_{ij} = f_{1i} * f_{2ij}$	$w = 1/f_{ij}$	$w_{non-response}$	w_{final}
Cluster number	Region	Cluster name	Number of beneficiaries	Probability of selection (first stage)	Beneficiary number	Beneficiary name	Probability of selection (second stage)	Probability of selection (overall)	Sampling weight for probabilities of selection	Sampling weight for nonsponse	Final sampling weight
4	Central Region	Glokta	22	0.2514	2	G. Grafiti	0.3636	0.0914	10.94	1.143	12.50
					~~5~~	~~G. Smithy~~	~~0.3636~~	~~0.0914~~	~~10.94~~	~~1.143~~	~~12.50~~
					8	Ch. Shaltitch	0.3636	0.0914	10.94	1.143	12.50
					11	W. Zebreeks	0.3636	0.0914	10.94	1.143	12.50
					13	V. Augustus	0.3636	0.0914	10.94	1.143	12.50
					16	R. Hornshnutz	0.3636	0.0914	10.94	1.143	12.50
					19	Du. Poonts	0.3636	0.0914	10.94	1.143	12.50
					22	M.N. Shevitz	0.3636	0.0914	10.94	1.143	12.50

CHAPTER

12. Producing Estimates of Indicators

After producing final sample weights to be used in data analysis, the next step is to produce estimates for the four agriculture-related annual monitoring indicators that are the focus of this guide, as well as for any of the other Feed the Future annual monitoring indicators for which data were collected through the BBS.[46] As mentioned earlier, the four agriculture-related annual monitoring indicators are either totals ("Number of Hectares under Improved Technologies" and "Number of Farmers and Others Using Improved Technologies") or are composites of totals ("Value of Incremental Sales" and "Gross Margins").

The aim of BBSs is to facilitate the production of estimates that represent the entire population of beneficiaries, not just the beneficiaries in the survey sample. To do so, the sample weights are used to "inflate" the data from each of the sampled beneficiaries who responds, so that a sample-weighted sum of the data from the surveyed beneficiaries provides an estimate of the total (relating to the indicator in question) for the entire population of beneficiaries. The formula for an estimate of a population total is:

$$estimate\ of\ population\ total = t = sum(w_{final_i} * \ y_i)$$

where:

w_{final_i} = value of w_{final} (the final sampling weight) for the *ith* sampled beneficiary, and

y_i = the value of y, the contribution to the indicator (or data point) for the *ith* sampled beneficiary.

For example, to produce an estimate for the "Number of Hectares under Improved Technologies" indicator for the entire survey population of beneficiaries, y_i represents the number of hectares under improved technologies for survey respondent *i*. This value is multiplied by the corresponding final sampling weight (w_{final_i}) for respondent *i*. The same is done for all other survey respondents, and then these values are summed across all survey respondents to produce an estimate of the population total (t).

It can be complicated and time consuming to compute estimates of totals for all annual monitoring indicators required by Feed the Future, and therefore survey implementers should use a statistical software package, such as SAS, SPSS, or STATA, to generate the estimates.

[46] Note that Feed the Future FFP and non-FFP IPs are required to compute and report on the five data points for the "Gross Margins" indicator, as well as on the data points (total sales and number of beneficiaries for the current reporting and base years) for the "Value of Incremental Sales" indicator. They are not required to produce estimates of these two indicators directly.

12.1 Producing Estimates for the Two Totals Indicators

Estimates for the "Number of Hectares under Improved Technologies" and "Number of Farmers and Others Using Improved Technologies" indicators are produced by a direct application of the formula given at the beginning of this chapter, using one of the software packages mentioned earlier.

12.2 Producing Estimates for the Two Composites of Totals Indicators

The "Gross Margins" indicator is calculated using a formula that includes five distinct components or data points, as defined in Section 2.1. Note that each of the five components that comprise the "Gross Margins" indictor is itself a total, and therefore each component should be estimated using the formula that integrates the sample weights provided at the beginning of this chapter.

For the "Value of Incremental Sales" indicator, each of the two main components ($VS_{reporting\ year}$ and $VS_{base\ year}$ from the formula in Section 2.2) is itself a total. The values for $VS_{reporting\ year}$ *and* $VS_{base\ year}$ are estimated using data collected from the BBS (for the reporting year and base year, respectively) using the formula for producing an estimate of a population total given at the beginning of this chapter.

Once sample-weighted estimates of each of the components are produced (five for the "Gross Margins" and two for "Value of Incremental Sales") through one of the software packages, the estimates should be individually entered into the FFPMIS or the FTFMS. Feed the Future requires that projects report information on the number of beneficiaries at each of the two time points for "Value of Incremental Sales" as well. Once all inputs are entered, the FFPMIS and FTFMS systems will automatically produce estimates for the "Gross Margins" and "Value of Incremental Sales" indicators, respectively.

12.3 Comparing Indicator Values over Time

Because Feed the Future IPs tend to increase the number of beneficiaries in their projects in the first few years of project implementation, and then decrease the number of beneficiaries as they phase out the project in the last year, for most Feed the Future projects, the pool of beneficiaries for one year is not the same as the pool of beneficiaries for any other year. This introduces a challenge when attempting to compare any of the annual monitoring indicator values over time.

For instance, if we observe that the "Number of Farmers and Others Using Improved Technologies" indicator increased from one year to the next, it is not clear whether the increase was due to an improved adoption rate among beneficiary farmers or to an expansion of the number of direct beneficiary farmers in the project between the two years. Although the underlying intention of the indicator is to be able to track increased adoption rates, it is difficult to tease out this component directly. Therefore, IPs should carefully interpret the comparison of results over time, taking into account the number of beneficiaries in any given year, to be able to identify the trend of true interest. One way of doing this is to use the estimates of totals and to compute the average values per beneficiary; the average values can easily be computed and compared over time.

CHAPTER

13. Producing Confidence Intervals and Standard Errors Associated with the Indicators

An important step in data analysis is to calculate confidence intervals and standard errors for all estimates where the data have been collected through a BBS. A confidence interval is a measure of the reliability of an estimate and is expressed as a range of numbers that have a specific interpretation. A standard error is an alternative measure of reliability of the estimates of the indicators produced. It quantifies how precisely the true value of the total is known and takes into account the value of the standard deviation, as well as the values of the actual sample size and the population size.[47] Although the reporting of confidence intervals and standard errors is not required by the FFPMIS or FTFMS, Feed the Future IPs should produce them and include them in their annual monitoring documentation, to provide a measure of the level of reliability of the estimates of indicators produced.

Survey implementers should use a specialized statistical software package that can take into account the complex design features of BBSs, such as clustering and unequal probabilities of selection, to generate the confidence intervals and standard errors.

The most widely used statistical software packages are SAS, SPSS, and STATA. Each of these packages has its own specialized syntax for entering information on complex survey design features (such as clustering and sample weights) that permits the production of survey-based estimates of totals, along with their associated confidence intervals and standard errors. It is critical that the correct syntax for complex survey designs be used, and therefore users should thoroughly familiarize themselves with such software before undertaking any data analysis. See Table 6 for details on some statistical software packages that can be used.

Table 6. Statistical Software Packages for the Analysis of Complex Survey Data

Statistical software package	For analyses of complex survey data, use…
SAS	Specialized survey procedures (e.g., PROC SURVEYMEANS)
SPSS	SPSS Complex Samples module
STATA	*svyset* and *svy:total* syntax

[47] A distinction should be made between the standard deviation of a distribution and the standard error of an estimate. The standard deviation is defined at the level of the beneficiary and quantifies "scatter" by describing how individual data points vary from one another across the distribution of beneficiary values. The standard error provides a measure of precision for the estimate (of an indicator) and is a companion measure to the confidence interval.

13.1 Calculating Confidence Intervals and Standard Errors Associated with Estimates of Totals

The formula to calculate a confidence interval with a confidence level of 95% for the estimate of a total (denoted by t) is the following:

$$CI_{total} = estimate\ of\ total\ (t) \pm \left(z * \left(\frac{\sqrt{D} * s_{actual}}{\sqrt{n_{actual}}} \right) * N \right)$$

where:

t = the sample-weighted estimate of the total (discussed in Chapter 12)
z = the critical value from the Normal Probability Distribution (discussed in Section 9.2.2)
D = the design effect for the survey
s_{actual} = the standard deviation computed from the survey data
n_{actual} = the actual sample size realized after fieldwork
N = the total number of beneficiaries (discussed in Section 9.2.2)

For a confidence level of 95%, the corresponding critical value, z, is equal to 1.96. Survey implementers should use a confidence level of 95% (and a critical value of 1.96) for calculating confidence intervals, although values for critical value based on other confidence levels can be found from tables, statistical software, and spreadsheet software (such as Microsoft Excel).

In terms of the design effect for the survey, recall that an estimate of the design effect, $adj_{design\ effect}$, is used as an adjustment in the calculation of the target sample size (n_{final}), as discussed in Section 9.2.3. In contrast, the design effect that should be used in the computation of the confidence interval in the formula above is one that is computed by the statistical software using data from the fieldwork, and is denoted by D.

In the above formula, n_{actual}, represents the actual sample size realized after fieldwork. This is in contrast with n_{final}, described in Section 9.2.4, which is the target sample size calculated prior to fieldwork and which takes into account the anticipated non-response. The two sample sizes—n_{actual} and n_{final}—differ in that n_{actual} typically will be somewhat lower than n_{final} given that some non-response may be encountered in the field.

In terms of the standard deviation of the distribution, recall that an estimate of the standard deviation, s, used in the calculation of the target sample size (n_{final}) is discussed in Chapter 9. In contrast, the standard deviation that should be used in the computation of the confidence interval in the formula above is one that is computed by the statistical software using data from the fieldwork, and is denoted by s_{actual}.

The formula to calculate the standard error associated with the estimate of a total, t, is the following:

$$standard\ error(t) = SE(t) = \left(\frac{\sqrt{D} * s_{actual}}{\sqrt{n_{actual}}} \right) * N$$

Both the confidence interval and the standard error associated with the estimate of the total should be reported as measures of precision of the estimate. As discussed in the previous chapter, estimates of the confidence intervals and standard errors should not be computed using formulas found in spreadsheet software such as Microsoft Excel. Rather, statistical software (such as SAS, SPSS, and STATA) should be used to produce confidence intervals and standard errors, so that elements of the complex survey design are appropriately taken into account. The formulas given above are provided to give the reader a sense of the computations undertaken by the statistical software packages. Alternatively, users can use the statistical software to produce values for the inputs to the above formulas (i.e., *D*, s_{actual}, and *t*), and then plug these inputs directly into the above formulas to obtain values for CI_{total} and $SE(t)$.

13.2 Interpreting Confidence Intervals

The interpretation of a confidence interval is nuanced and will be illustrated through the following example. Suppose the estimate for the "Number of Hectares under Improved Technologies" indicator is 63,300 hectares and suppose that a 95% confidence interval for the estimate of the indicator is (60,904; 65,695).

The correct way to interpret the above confidence interval is as follows: If a large number of surveys was repeatedly conducted on the same beneficiary population and if confidence intervals were calculated for each survey conducted, 95% of the confidence intervals would contain the true value of the indicator representing the entire population. The confidence interval from the given sample is one such interval.

This does **not** mean that the probability is 0.95 that the true value of the total number of hectares for the population is contained in the interval (60,904; 65,695). This is often incorrectly used as the interpretation for such a confidence interval.

13.3 An Example of Calculating a Confidence Interval and a Standard Error for an Estimate of a Total

The example below illustrates the computation of a confidence interval and a standard error for an estimate of the "Number of Hectares under Improved Technologies" indicator. We assume a population of beneficiaries of size *N* = 30,000. We also assume that data from a BBS with an actual sample size of n_{actual} = 450 and a design effect of *D* = 2 is used to compute a sample-weighted estimate of total (*t* = 63,300) and an associated actual standard deviation (s_{actual} = 0.611).[48] A 95% confidence interval around *t* = 63,300 is then given by (60,904; 65,695) and the standard error of the estimate is computed as 1,222.

[48] Although the figure of s_{actual} = 0.611 may seem small relative to the other figures, recall that the standard deviation is defined at the level of the beneficiary and it describes how the individual values vary from one another.

Survey-weighted estimate of total hectares under improved technologies	t	63,300	*= derived from survey data*
Standard deviation	s_{actual}	0.611	*= derived from survey data*
Total number of beneficiaries	N	30,000	
Sample size	n_{actual}	450	
Confidence level	CL	0.95	
Z statistic	*z*	1.96	
Design effect	*D*	2	

CONFIDENCE INTERVAL(CI) AND STANDARD ERROR

CI: Lower limit = LL

$$60{,}904 = t - \left(z_{0.95} * \frac{\sqrt{D} * s_{actual}}{\sqrt{n_{actual}}} * N \right) = 63{,}300 - (1.96 * \frac{\sqrt{2} * 0.611}{\sqrt{450}} * 30{,}000)$$

CI: Upper limit = UL

$$65{,}695 = t + \left(z_{0.95} * \frac{\sqrt{D} * s_{actual}}{\sqrt{n_{actual}}} * N \right) = 63{,}300 + (1.96 * \frac{\sqrt{2} * 0.611}{\sqrt{450}} * 30{,}000)$$

CI: (Lower limit, Upper limit) = (LL, UL) (60,904, 65,695)

Standard Error of the Estimate

$$1{,}222 = \frac{\sqrt{D} * s_{actual}}{\sqrt{n_{actual}}} * N = \frac{\sqrt{2} * 0.611}{\sqrt{450}} * 30{,}000$$

13.4 Calculating Confidence Intervals and Standard Errors for the "Gross Margins" and "Value of Incremental Sales" Indicators

Since the "Gross Margins" indicator is not a total, but rather a composite of five components each of which is a total, the computation of associated confidence intervals and standard errors of the overall estimate of the indicator is extremely complex and beyond the scope of this guide. Therefore, the recommendation is that the computation of confidence intervals and standard errors for this indicator be omitted (although it is possible to compute confidence intervals and standard errors for each of the five components).

The "Value of Incremental Sales" indicator comprises two components—the value of sales for the current reporting year and the value of sales for the base year—and can be expressed as an adjusted difference of totals. If the data for the value of sales for the current reporting year and the base year have both been collected through a BBS, then computing the confidence interval and standard error for the "Value of Incremental Sales" indicator is technically possible, but uses a formula that is more complex than the one given in the section above for estimates of totals. Again, for these reasons, the recommendation is that the computation of confidence intervals and standard errors for this indicator be omitted.

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ANNEX

Annex 1. Scope of Work Template for Beneficiary-Based Survey

Scope of Work for External Contractor

Beneficiary-based survey for annual monitoring
Name of Project, Name of Country
Date of issue

1. BACKGROUND

Background and objectives of project
Provide context that covers the origin and evolution of the project, including the start and end dates and number of years in operation. Broadly state the project's goal, objectives, and expected outcomes; the strategies it is following; and the type of interventions it is undertaking to meet its objectives. Finally, include information on the donor and funding level of the project.

Geographic scope of project
Indicate the geographic scope of the project and how this has changed in the past or is expected to change in the future, in addition to the number of beneficiaries reached.

Project stakeholders
Provide background information on the respective roles of all project stakeholders.

Previous surveys
Identify any previous beneficiary-based surveys, whether done internally or by other organizations, which covered the same (or similar) topics for the same (or similar) beneficiary populations in the same (or similar) geographic area. Indicate whether reports are publicly available, and give their title and source (including web address).

2. SCOPE OF WORK

State that the survey to be conducted should be beneficiary-based and that the contractor will be responsible for the following aspects of the survey (although this can be modified to include or exclude any of these components, should the decision be made to undertake some of these in-house instead):

a. Survey design/sampling plan
   - Sample size calculation
   - Clustering and selection of units at each stage of sampling
   - Specification of methodology for selecting beneficiaries at the final stage

b. Questionnaire development
   - Development of questionnaire instrument(s)
   - Pre-testing, finalizing, and translating questionnaire(s) into local languages
   - Printing of questionnaires

c. Equipment and logistics
   - Provision of all necessary field equipment (tablets, GPS units, etc.)
   - Securing of office and computer equipment for survey management and data entry
   - Arranging for transportation, lodging, and equipment for fieldwork

d. Data collection
   - Recruitment of fieldwork staff (data collectors, supervisors, data entry)
   - Development of training guide for data collectors
   - Training of data collectors and supervisors
   - Design and oversight of listing operations (if applicable)
   - Conducting and overseeing of data collection

e. Data entry and data cleaning
   - Development of data entry software and data entry protocols (latter only required for paper-based data collection)
   - Development of quality control measures for data entry and data cleaning
   - Data cleaning to ensure logic and consistency checks

f. Data analysis, production of estimates, and report writing
   - Calculation and use of sampling weights
   - Production of estimates and disaggregates of indicators that ensure complex sample design taken into account
   - Production of confidence intervals and standard errors of indicator estimates
   - Submission of report with findings
   - Submission of documented data sets where the identity of individual beneficiary respondents have been anonymized or otherwise had their confidentiality protected

Also list the topics from above for which the contractor will not be responsible.

3. SURVEY OVERVIEW

Survey objective(s)
Describe the main objective(s) of the survey.

Survey type
It should be made clear to the contractor that this is a descriptive survey of beneficiaries in support of annual monitoring.

Geographic scope of survey
Provide the location names, administrative units, and other pertinent details on the geographic area that the beneficiary-based survey will cover. Indicate if the scope of the survey differs from the scope of the project.

Survey population of beneficiaries
Provide a written description of the beneficiary population (e.g., direct beneficiary farmers living in a particular district). Provide a total overall number for the survey population in villages, farmer groups, and/or other units. Also provide the source(s) from which these totals were taken.

List of Feed the Future annual monitoring indictors to be reported on through the beneficiary-based survey
A list of Feed the Future annual monitoring indicators (as well as any custom indicators) for which underlying data are to be collected through the beneficiary-based survey should be provided to the contractor. These should include, at a minimum, the four challenging indicators that are the focus of this guide. The PIRSs associated with these indicators should be provided to the contractor as well. (The complete set of Feed the Future non-FFP annual monitoring indicators and their PIRSs can be found in the publication "Feed the Future Indicator Handbook: Definition Sheets," which is located at http://feedthefuture.gov/resource/feed-future-handbook-indicator-definitions)

Main audience of survey
The main intended audience for the survey report should be indicated.

Expected dates and duration of consultancy
The expected time frame and duration of the contract should be specified. Refer to the section on "Work Plan" in Section 7 of this scope of work.

4. SURVEY DESIGN/SAMPLING PLAN

Indicators to be used as basis for sample size calculations
Indicate the key indicators (preferably no more than five and including the three suggested earlier in this guide) that will serve as a basis for the sample size calculation. Also state if any data exist on the current value of each of the key indicators within the target populations (from a survey conducted by another organization, for example). Specify the levels of disaggregation required for which indicator estimates must be produced.[1]

Sample size calculation
If the sample size calculation is to be produced by the contractor, this should be stated. In this case, the project should provide to the contractor all relevant inputs for such computations (e.g., number of population beneficiaries and targets for indicators, as well as any relevant information from prior surveys [if it exists], such as values of indicators and standard deviations, the design effects, and the non-response rates/response rates). The project can opt to specify the desired level of confidence (e.g., 95%), as well as the acceptable percentage error (p) for the MOE, or can leave the specification of these parameters to the contractor.

Sampling frame(s) and coverage for beneficiary-based survey
Describe the lists from which beneficiaries will ultimately be selected.

Frame of Clusters: If cluster sampling is to be used, describe the lists of geographic units that will be used (e.g., villages/communities or farmer groups). In the case that survey design option 1 or 2 is to be used, it should be stated that a complete list of implementation clusters (villages or communities) will be provided to the contractor. If survey design option 4 is to be used, it should be stated that a complete list of farmer groups will be provided to the contractor.

Frame of Beneficiaries: In the case that survey design option 1, 3, or 4 is to be used, then a complete, comprehensive, and up-to-date list of beneficiaries should be provided to the contractor for the second stage of sampling. If survey design option 2 is to be used, it should be stated that a complete list of

[1] It should be made clear to the contractor that separate sample size calculations for the various required disaggregates for Feed the Future annual monitoring indicator need not be undertaken.

beneficiaries does not exist and that a listing operation will be required to create such a list as part of survey taking.

Finally, specify whether the lists provided cover the entire beneficiary population. If not, specify the areas/beneficiaries that are not covered by the lists.

Sample selection
If the contractor will be responsible for developing the sample design, state that the contractor should select units at each stage of sampling in accordance with the possible options below:

Household survey approach

- Survey design option 1 – two-stage cluster design with systematic selection of beneficiaries
- Survey design option 2 – two-stage cluster design with listing operation and systematic selection of beneficiaries
- Survey design option 3 – one-stage design with systematic selection of beneficiaries

Farmer groups approach

- Survey design option 4 – two-stage cluster design with "take all" selection of beneficiaries

Sampling weights and the treatment of non-response
It should be specified that the contractor is expected to produce sampling weights for each beneficiary record on the sampling file to be used in the analysis of data. In addition, the contractor should make adjustments to the final weights to compensate for any residual non-response encountered at the beneficiary level.

Production of indicator estimates
The final report should include tables with the following information for each indicator:

Indicator Name or Data Point[a]	Level of Reporting (overall or disaggregate)	Value of Indicator	Standard Error of Indicator	Confidence Interval		Design Effect	Number of Cases	
				Lower Limit	Upper Limit		Number of Respondents	Number of Non-Respondents

[a] Only the component data points need to be reported for the "Gross Margins" and "Value of Incremental Sales" indicators. The values of the indicators themselves will be produced by FFPMIS and FTFMS using the reported component data points.

5. SURVEY QUESTIONNAIRE(S)

Questionnaire development
State whether a questionnaire has already been drafted, or whether the contractor will need to develop a new questionnaire for the survey. If a questionnaire from a prior survey is to be used as a basis for development for the questionnaire, it should be provided along with details regarding estimated time per completed questionnaire module or interview. If the contractor needs to develop a new questionnaire from scratch, a list of indicators for which questions must be developed should be provided, along with their associated PIRSs.

Translation of questionnaire
State whether the questionnaire needs to be translated or whether a translation will be undertaken by the Feed the Future IP. Explain who will be responsible for engaging the translation service and funding translation costs, and whether forward- and backward-translation is required. Make sure that translation time is taken into account in the work plan.

Pre-testing and finalization of questionnaire
State if field pre-testing is required to test the flow, filters, and skip patterns in the questionnaire. Give any known details on pre-testing: expected duration, pre-testing sites, choice of pre-test respondents, and number of pre-tests required, as well as the timeline for questionnaire finalization.

6. FIELDWORK OPERATIONS

Human resources for fieldwork
State the human resource requirements for fieldwork by position, including both those that will be provided by the organization and those that will be provided by the contractor. State the expected level of education and/or experience, as well as their employment status (volunteer, employee, etc.).

Listing operation(s)
Provide necessary details on expectations relating to listing operation(s) (survey design option 2 only), such as how much information on each beneficiary should be collected and whether GPS information on the beneficiary dwellings and/or clusters is required as well. Specify whether GPS equipment will provided by the project or by the contractor. Indicate if the contractor will need to produce any maps during the listing exercise.

Training of data collectors
Provide details on the expectations relating to the training of data collectors, including expected duration and expected types of activities (e.g., piloting field operations, pre-testing of questionnaire).

Mode of data collection
The preferred mode of data collection should be specified in the scope of work.

- Personal interviews with paper questionnaires
- Personal interviews with PDAs (personal digital assistants) or other computer-assisted collection
- Other (please specify)

Data entry
If data collection is paper-based (rather than tablet-based), state whether the contractor will be responsible for providing a system to input and manage data entry, and whether there are any specific hardware or software requirements. State if double data entry is expected. State any expected quality control mechanisms that the contractor will need to put in place to ensure consistency and logical coherence of the data during data cleaning.

7. WORK PLAN, DELIVERABLES, AND DISSEMINATION

Work plan
The contractor should submit a plan of activities, the following of which is an example. A Gantt chart can also be used in place of a table.

Activities	Number of Days	Expected Dates	Person(s) Responsible
1. Desk review and discussions with project staff	2		
2. Develop and submit an inception report for approval, which should include the following: • work plan • survey design/sampling plan, including sample size calculations • data treatment (including quality control measures) and analysis plan	10		
3. Develop survey instrument(s) and translate into relevant local languages	10		
4. Develop data entry system designed for survey, as well as data entry protocols and specifications (in case of paper-based data collection)	10		
5. Recruit data collectors	30		
6. Develop training agenda and materials (and translate)	10		
7. Train data collectors	5		
8. Pre-test and finalize survey instrument(s)	5		
9. Oversee listing operation(s)	5		
10. Collect data	20		
11. Enter, clean, and analyze data	10		
12. Prepare table of indicator estimates and write short report	10		
13. Prepare data set for submission	5		

Deliverables

The contractor should be given a set of expected deliverables and their deadlines. Indicate the language required for all deliverables and what role, if any, the contractor is expected to play in translations or reviews of translated text. Also state any page limitations. The following is an example of a set of deliverables:

Deliverables	Expected Deadline
1. Inception report (which includes the work plan, survey design/sampling plan, and data treatment and analysis plan)	
2. Finalized survey instrument(s), in English and in relevant local language(s)	
3. Training manual(s) for field staff, in English and in relevant local language(s)	
4. All data files in SAS, SPSS, or STATA format (sampling frame[s], raw data sets, transformed data sets and syntax, edit rules, code book/data dictionary, sampling weights)	
5. Tables of indicator estimates along with their confidence intervals and standard errors; short report	

8. LOGISTICS AND REPORTING

Logistics and administrative support
The scope of work should indicate any requirements that have a bearing on costs (such as travel) and state who will finance them. It should be clear on the extent to which any human resources (e.g., translator, driver) or logistical support (e.g., computers, office space, vehicles) will be provided free of charge to the contractor.

Reporting relationships
The name and title of the designated survey manager within the Feed the Future project to whom the contractor will report should be stated.

Language on future use of data
Within the scope of work, language should be included to the following effect: "The completed data set will be the sole property of USAID. The contractor may not use the data for its own research purposes, nor license the data to be used by others, without the written consent of USAID." Precise wording can be crafted in consultation with USAID.

9. OBLIGATIONS OF KEY PARTICIPANTS IN SURVEY

It is useful to detail the obligations of each party in the survey to set realistic expectations and accountabilities. The following is an example.

Contractor

a. Inform the survey manager in a timely fashion of progress made and of problems encountered.
b. Implement the activities as expected, and, if modifications are necessary, bring them to the attention of the survey manager before enacting any changes.

Feed the Future project survey manager

a. Ensure that the contractor is provided with the specified documents and adequate human resources and logistical support.
b. Facilitate the work of the contractor with beneficiaries and other local stakeholders.
c. Answer day-to-day enquiries, monitor the daily work of the contractor, and flag concerns.

Feed the Future project technical staff

a. Review and approve the proposed methodology.
b. Provide technical oversight in the review of all deliverables.
c. Provide timely comments on any draft reports.

10. REQUIRED QUALIFICATIONS OF CONTRACTOR

The scope of work should state the required qualifications expected for all key positions and how this information should be presented in the bid or proposal. Any language or diversity requirements that factor into the selection decision should be indicated. Illustrative examples of job descriptions for key survey team members can be found in Annex 2.

11. SUBMISSION OF PROPOSALS

Proposal submission details
The scope of work should be clear on which documents to submit, how proposals should be submitted (by email, uploading to website, regular post, etc.), and to whom to address proposal submissions. The exact date and time deadline (with time zone) for receiving bids should be given. It should be clearly specified that any bids received after the deadline will not be considered.

Proposal outline
A suggestive format for the proposal is outlined below:

a. **Background**: Brief background about the objectives of the study should be included in the proposal.

b. **Work plan**: The proposal should clearly mention details of each and every activity, including those mentioned in the work plan in Section 7.1 of this scope of work. The timeline and person(s) responsible for each activity should be clearly stated.

c. **Survey design/sampling plan**: The proposal should provide information on the overall survey design, covering an overview of the treatment of all of the items in Section 4 of this scope of work.

d. **Training**: The proposal should state who will be responsible for training data collectors and should describe the topics covered, expected duration, and logistic and administrative support needed.

e. **Field team**: There should be a clear indication in the proposal of the number of individuals needed for data collection and listing operations, by position.

f. **Quality control mechanisms during data collection**: The proposal should provide a section that details the mechanisms that will be put in place to ensure data quality, clearly specifying steps for data validation. This section may also include supervisory mechanisms for data quality and the role of field editors.

g. **Data entry and processing plan**: This section of the proposal should clearly state details on data entry (if paper-based data collection is used), validation (logical and consistency) checks, and other data-processing activities.

h. **Data analysis and report writing**: The proposal should provide details on the analyses that will be carried out and on the person/people responsible for data analysis and the writing of the summary report.

i. **Contractor division of labor**: There should be a section of the proposal that provides information on key professionals and their level of effort for the different activities of the survey. An illustrative matrix is provided below:

Name	Level of Effort (number of days)						
	Sampling Plan	Instrument Development	Training	Data Collection	Data Entry and Cleaning	Data Analysis	Short Report (including tables of indicator estimates)

j. **Contractor Expertise**: This section of the proposal should highlight past experience of the contractor in conducting similar surveys, preferably with complex sample designs and in developing countries. The section should mention names, qualifications, and experiences of all persons who would be involved in various aspects of conducting the survey.

k. **Progress updates:** This section of the proposal should clearly indicate the mechanism that will be used to communicate with the Feed the Future project survey manager in providing regular updates on field activities, coverage rate, data entry status, etc.

Detailed Budget: There are three approaches that can be taken concerning the budgeting of the evaluation:

- No budget is specified and bidders are requested to provide both technical and financial proposals. In this case, bidders can specify a preferred methodology, estimate its costs, and have control over their ability to meet the deliverables.
- The project specifies a maximum budget in the scope of work and the bidders are requested only to provide technical proposals. Bidders are expected to match their proposed methodology and work plan to the budget.
- The project specifies a maximum budget in the scope of work and invites both technical and financial proposals to see if the contractor has a good understanding of how much it will cost to carry out the needed tasks and if funds can be economized. However, bids will not usually come in for much less than the maximum budget specified and selection will usually be on the basis of the quality of the technical proposal.

Under option (a), a wider range of proposed methodologies may be received, although some may exceed the maximum amount budgeted for the survey. Under options (b) and (c), the Feed the Future IP can more directly control the budget, but in some cases this approach may lead to a lower number of proposals and/or proposed methodologies that are suboptimal in terms of rigor or scope.

If a budget is required as part of the proposal, it should provide the estimated budget for each activity, clearly mentioning rates and how rates are estimated. Possible line items are suggested below:

a. Daily rate of key professionals
b. Travel costs
c. Training costs
    i. Listers/mappers, supervisors, data collectors, data editors
    ii. Instrument pre-testing and field operations piloting costs
    iii. Other costs

d. Field expenses
    i. Payment of field staff (e.g., listers/mappers, supervisors, data collectors, data editors)
    ii. Travel cost of field staff during data collection (e.g., accommodations, per diems)
    iii. Other costs (e.g., printing of questionnaires, vehicles, GPS equipment)
e. Data entry (including laptops and computer software)
f. Data cleaning, analysis, and report writing
g. Preparation of data sets for sharing
h. Other costs

12. SELECTION PROCESS

The selection process and the criteria that will be used should be described.

Questions from bidders
Before the deadline for receiving bids has passed, a clear protocol should be developed on how to accept and respond to questions from potential bidders. Answering questions from potential bidders will likely increase the quality of received proposals. Typically, a clear deadline is specified by which any questions must be submitted (and to whom they should be addressed), and an indication is also given regarding when responses will be provided. A specified process should be put in place through which questions are collected during a certain time period, typically using an online mechanism where bidders do not need to reveal their identities to other bidders. Answers should then either be posted online or sent by email to all bidders.

ANNEX

Annex 2. Illustrative Job Descriptions for Key Survey Team Members

SURVEY TEAM LEADER

1. Postgraduate degree from a recognized university in development studies, project management, project monitoring and evaluation, or other relevant field of study
2. Minimum of 5 years of experience in a *senior* management position for an international development organization
3. Prior experience leading at least two large-scale, complex beneficiary-based or household surveys (preferably in resource-constrained environments)
4. Demonstrated expertise in managing budgets, staff, logistics, contracting, and other support staff issues
5. Strong experience in partnering and interacting with international multinational donors and in-country governmental authorities
6. Excellent interpersonal, presentation, and communication skills, and a demonstrated ability to deliver a high-quality product
7. Prior professional experience in country or region preferred
8. Fluency in English (or French for Francophone countries or Spanish for Spanish-speaking countries, etc.) required; fluency in relevant local language(s) an advantage

SENIOR SURVEY SPECIALIST

1. Postgraduate degree from a recognized institution relating to survey methodology, statistics, monitoring and evaluation, or social sciences research
2. Experience designing and leading the implementation of large-scale, clustered, multistage beneficiary-based or household surveys (preferably in resource-constrained environments)
3. Experience developing survey inception reports and work plans, and in managing the administrative, logistical, and budgetary functions of large-scale surveys
4. Experience developing, overseeing translations of, pre-testing, and finalizing survey instruments
5. Experience in developing survey training materials and data collection manuals (for supervisors and data collectors)
6. Experience in overseeing data entry (for paper-based data collections) and editing processes
7. Expertise analyzing complex survey data (including calculating sampling weights); strong knowledge of at least one statistical software package (CS-PRO, SAS, SPSS, STATA, SUDAAN, etc.)

8. Experience presenting survey results to high-level project stakeholders
9. Prior experience with surveys with similar purpose, mode, and populations strongly preferred
10. Prior professional experience in country or region preferred
11. Fluency in English (or French for Francophone countries, or Spanish for Spanish-speaking countries, etc.) required; fluency in relevant local language(s) an advantage

FIELD OPERATIONS MANAGER

1. Undergraduate degree from a recognized institution
2. Experience supervising fieldwork for large-scale beneficiary-based or household surveys (preferably in resource-constrained environments)
3. Experience recruiting, training, and managing field supervisors and data collectors
4. Experience coordinating field logistics, schedules, and equipment
5. Experience managing data quality control in the field during survey implementation
6. Strong interpersonal skills, ability to solve problems when confronted with roadblocks during survey fieldwork
7. Prior professional experience in country or region preferred
8. Fluency in English (or French for Francophone countries, or Spanish for Spanish-speaking countries, etc.) required; fluency in relevant local language(s) also required

ANNEX

Annex 3. Checklist for Engaging External Contractors

#	Evaluation factor	Critical	Important
1	Survey team leader has designed and led **a minimum of two** large-scale, complex beneficiary-based or household surveys (i.e., clustered, multistage surveys) in resource-constrained environments **in the past 5 years**	✓	
2	Senior survey specialist has demonstrated expertise in calculating sample sizes, designing surveys, and analyzing complex survey data	✓	
3	Survey team includes, **at a minimum**, a survey team leader, a senior survey specialist, and a field operations manager	✓	
4	At least one member of the survey team (or local subcontracting team) speaks each local language in which the survey will be administered	✓	
5	Contractor proposal includes high-quality sampling plan that adheres to all requirements specified in the scope of work	✓	
6	Contractor proposal includes details on quality control processes to be used before, during, and after data collection	✓	
7	Contractor can provide contact information for professional references for whom contractor has implemented surveys in the past	✓	
8	Contractor has previous survey-related experience in the country		✓
9	Contractor proposed work plan includes local government approvals		✓