FEED THE FUTURE

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

Feed the Future Agricultural Indicators Guide

Guidance on the collection and use of data for selected Feed the Future agricultural indicators

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revised March 2015

USAID

FROM THE AMERICAN PEOPLE

Recommended Citation:

Nelson, S. and A. Swindale, September 2013, Feed the Future Agricultural Indicators Guide. Rockville, MD: Westat.

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Acknowledgements

The authors thank all of the Feed the Future Mission, implementing partner, USG agency and other stakeholders who contributed their time and input regarding the challenges they have faced using Feed the Future agricultural indicators and their insights into possible solutions. We thank Mark Langworthy, John Wyeth, Tom Bower, Ben Langworthy, and Laurie Starr for their contributions and help throughout this process. We also thank Aruna Jhasti, Carl Riley, Chris Green, and Alesia Wilson-Hull for their superb technical support to a series of webinars conducted in conjunction with development of the Guide, and Joe Stuckey and Julie MacCartee for facilitating the webinars. Finally, we thank Salik Farooqi and Lesley Perlman for their contributions to the 2015 revised version of the Guide to reflect key changes in indicator definitions.

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List of Acronyms

FAO	Food and Agriculture Organization of the United Nations
FANTA	Food and Nutrition Technical Assistance
FFP	Food for Peace
FTFMS	Feed the Future Management System
GIS	Geographic Information Systems
GPS	Global Positioning Systems
IM	Implementing Mechanism
IP	Implementing Partner
IPM	Integrated Pest Management
MOA	Ministry of Agriculture
NDVI	Normalized Difference Vegetation Index
PDA	Personal Digital Assistants
RiA	Required-if-Applicable
RF	Results Framework
TOT	Training of Trainers
USAID	United States Agency for International Development
WFP	United Nations World Food Programme
WOG	Whole of Government

Introduction

The Feed the Future Agricultural Indicators Guide (Guide) was developed as additional guidance to the Feed the Future Indicator Handbook[1] that describes each of the "indicators selected for monitoring and evaluating the President's global hunger and food security initiative." As a working document, the Feed the Future Indicator Handbook has been revised several times since its initial distribution in 2010, most recently in October 2014. The revised Performance Indicator Reference Sheets (PIRS) for the four key indicators discussed in this Guide are found in Appendix 1. These revisions are reflected in the Guide and include:

- Gross margin indicator: Added instructions to report unit of measure for total production and volume of sales data points; and on how to report the gross margin and related indicators (number of farmers applying improved technologies, number of hectares under improved technologies, and incremental sales) when the production cycle starts in one fiscal year and ends in another;

- Number of hectares under improved technologies indicator: Dropped Duration (New/Continuing) disaggregate and added "Cultural practices" Technology Type disaggregate category

- Number of farmers and others applying improved technologies indicator: Dropped Duration (New/Continuing) disaggregate and added 1) Value Chain Actor Type and 2) Technology Type disaggregates; and

- Value of incremental sales indicator: Added an explanation of how the Feed the Future Monitoring System (FTFMS) uses the information on number of direct beneficiaries per value chain to calculate adjusted incremental sales values.

Objective of the Guide

The purpose of this Guide is to present clear and understandable guidance that will ensure best practices in the definition, collection, and use of key agricultural indicators for the annual performance monitoring of agricultural development activities under the U.S. Government's (USG's) Feed the Future Initiative.

The Guide provides clarifying information pertaining to, and examples of best practices for, the collection and use of key indicators to enable adherence to the highest possible technical standards by Feed the Future Implementing Partners (IPs). Recommendations are based on an understanding of the operational context and practical constraints facing Feed the Future IPs in their monitoring activities, as well as the specific requirements of the Feed the Future Monitoring System (FTFMS) and the need for greater consistency in data entered into the system, although data collection methods may vary.

[1] Feed the Future. 2014. http://feedthefuture.gov/resource/feed-future-handbook-indicator-definitions

The Guide will focus primarily on critical questions regarding a subset of four key indicators that relate directly to agricultural production, including:

4.5-16, 17, 18[2]	Gross margin per hectare, animal, or cage of selected product
4.5.2-2	Number of hectares under improved technologies or management practices as a result of USG assistance
4.5.2-5	Number of farmers and others who have applied improved technologies or management practices as a result of USG assistance
4.5.2-23	Value of incremental sales (collected at farm level) attributed to Feed the Future implementation

The gross margin per unit of land indicator number (4.5-16) will be used throughout the remainder of the Guide (unless specifically discussing gross margin for livestock or open water aquaculture products), due primarily to the heavy emphasis on land-based activities measured by hectares throughout; indicators 4.5-17 and 4.5-18 are implicit in all discussions of the gross margin indicator in this Guide.

Rationale for Selection of Key Indicators

The current Feed the Future indicators list is the source from which relevant indicators are selected by Missions and IPs for their country-specific activities, or Implementing Mechanisms (IMs). The particular indicators listed above have been selected for additional guidance because they provide important information on the annual progress of Feed the Future activities in promoting increased productivity and household income from agriculture, and because they present particular challenges in data collection and reporting within the FTFMS.

In particular, these four indicators represent a suite of hierarchically-related outcome indicators, each building on and enhancing the others directly as they contribute to the Intermediate Results (IRs) of improving agricultural productivity and expanding markets and trade, and ultimately, the goal of reducing poverty. As the value reported under indicator 4.5.2-5 (number of farmers and others applying improved technologies or practices) increases, more overall acreage comes under improved management practices and technologies that can lead to increased production and productivity, which is tracked through gross margin. Through improved market systems, this in turn leads to increased sales from targeted value chain commodities and household revenue, which is tracked through incremental sales. Ultimately, this leads to the overarching Feed the Future goal of reducing poverty, hunger, and undernutrition.

[2] Corresponds to PPR indicators: 4.5-16 farmer's gross margin per unit of land; 4.5-17 farmer's gross margin per unit of animal; and 4.5-18 farmer's gross margin per crate.

Methodology

To provide a basis for improving the quality of data collected by Feed the Future IPs on these indicators, and to resolve partner questions related primarily to how these indicators are defined and collected, one-on-one consultations and a series of webinars were conducted with IPs and other key informants with a stake in Feed the Future performance monitoring. The consultations and webinars provided a) a field-level perspective of the difficulties IPs face in meeting reporting requirements and providing meaningful data for the FTFMS, b) identification of issues and challenges to be addressed in the Guide, and c) practical examples of approaches (e.g., survey instruments, beneficiary tracking systems) being implemented. Consultations occurred April – May, 2013 and webinars were held May 29-31 and August 12-13, 2013. A review of primary and secondary literature was conducted on accepted methodologies and best practices for collecting data required by the four indicators. Samples of tools presented in the Guide have been adapted from examples provided by Feed the Future partners.

Limitations

The main limitation of the Guide is that it does not provide specific guidance on more than four key Feed the Future indicators. However, information and guidance presented herein can be applied to other Feed the Future indicators, as many of the key issues and challenges are common to more than one indicator. Guidance on additional indicators may be forthcoming but is beyond the scope of this Guide.

The Guide does not provide single solutions to the challenges and issues associated with collection and interpretation of the indicators. In many cases, there is no single best solution. Rather, viable alternative options are presented where feasible, along with brief discussion of the advantages and disadvantages of each. It is not possible to account for all operational contexts in which Feed the Future IPs are engaged; thus, there are no "one size fits all" solutions for how indicators should be measured. It is important, however, that Feed the Future IPs are all measuring the same thing (i.e., what is being measured), even if they're not measuring it in exactly the same way.

General Guidance

In addition to specific challenges with individual indicators, there was significant input from key informants on general challenges, ranging in topic from how to identify direct beneficiaries to budgeting for Monitoring and Evaluation (M&E). This section addresses various general challenges identified by Feed the Future partners, Missions and other stakeholders.

Annual Performance Monitoring

Findings from the consultations and webinars suggest a wide range in understanding of – and appreciation for – the importance of M&E among Mission, IP, inter-agency and other stakeholders. M&E is inextricably linked to program design, which is an important step in the project cycle.[3] The M&E system is an output of program design and allows for tracking and measuring change, helping to pinpoint where, when, and how the processes of change facilitated through project interventions are occurring (or not).

Fisheries

Open water fisheries programs present somewhat unique challenges regarding relevance of the indicators discussed here. For example, two of the four indicators covered in this Guide are not appropriate to such fisheries programs (i.e., gross margin, number of hectares under improved technology).

Interventions in open water fisheries programs often focus on governance and enabling environments issues (e.g., local conventions to control fisheries at sustainable levels, closed seasons). Neither gross margin (4.5-18) nor the number of hectares under improved technology or management practices (4.5.2-2) are appropriate as no reasonable unit of production (required for gross margin) could be defined for open water fisheries and because many interventions cannot be measured in area (required for the number of hectares indicator).

The other two indicators may be appropriate under certain circumstances. The number of farmers and others applying improved technology/practices (4.5.2-5) is appropriate for fisheries value-chain activities (e.g., processing, marketing). Likewise, the value of incremental sales indicator (4.5.2-23) is appropriate as long as beneficiaries are primary producers. Otherwise, other indicators – Feed the Future or custom – may be more appropriate for capture fisheries programs.

Monitoring provides managers and other stakeholders with regular feedback and early indications of progress or lack thereof in the achievement of intended results. Management and stakeholders use monitoring data, systematically collected on specified indicators, to assess ongoing development activity and implementation progress, and make relevant resource allocation decisions. As part of the M&E package employed by Feed the Future, annual performance monitoring and standard performance indicators track progress toward desired results as outlined in the Feed the Future Results Framework, including outcomes.[4]

Monitoring data is often collected through routine project records and beneficiary tracking data, such as attendance lists for training sessions, farmer/producer records, and association records. The Feed the Future Indicator Handbook indicates that annual performance monitoring for all four of the indicators covered in this Guide can be achieved through beneficiary-based surveys (i.e., surveys conducted with a census or sample of the beneficiary population), routine monitoring records, or both. Either approach is viable. However, how data for performance monitoring are collected has implications regarding costs. Surveys are likely to be more expensive than gathering data through existing records, although it may be the case that recordkeeping among many small-holder farmers and others is completely lacking or of dubious quality.

Costs. The U.S. Agency for International Development's (USAID's) guidance is to allow 5-10 percent of the total project budget for overall M&E; this includes the required 3 percent of the total project budget for evaluation.[5]

Selection of Indicators

Many agricultural-related Feed the Future indicators were used under a previous USAID initiative (Initiative to End Hunger in Africa) and were modified to varying degrees for the Feed the Future initiative. Until revised, they represent the pool of possible indicators from which Missions and IPs select annual performance monitoring indicators on which to report. Discussion of whether the four Feed the Future agricultural indicators covered here are "the best" for tracking progress toward Feed the Future goals is beyond the scope of the Guide.

Relevance of Indicators. In deciding whether to report on one of the four indicators highlighted in the Guide, Missions and IPs should determine whether the indicator is *relevant* to IM activities. In the Guide, "relevance" refers to whether the indicator is a meaningful measure relative to the project's goals. Activities must be directly linked to the results, objectives, and goals as described in the Results Framework (RF).

All Feed the Future focus countries report on the top two levels of the RF (i.e., goal and first-level objectives). However, each country must determine which of the Feed the Future second-level IRs and sub-IRs may have the greatest potential for change and are most appropriate to the contextual circumstances in which they operate.[6] Thus, project- and activity-level indicators are unique to each Feed the Future country and are determined by those parts of the Feed the Future RF on which they can have the most impact.

Of 53 total Feed the Future indicators, eight are required high-level impact indicators for focus countries. Missions then add indicators relevant to their IMs from the 23 required-if-applicable (RiA) indicators (nine of which are Whole of Government). They may also select from 22 standard (optional) indicators and create custom indicators. IPs track performance of output and outcome indicators, whereas the majority of the higher-level impact indicators are tracked through external M&E contractors through population-based surveys in the Feed the Future Zone of Influence. ***All of the indicators discussed in this Guide are RiA outcome indicators that are reported on an annual basis through beneficiary tracking efforts (e.g., routine records, beneficiary-based surveys)***.

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[5] USAID. 2012b.

[6] USAID. 2012a.

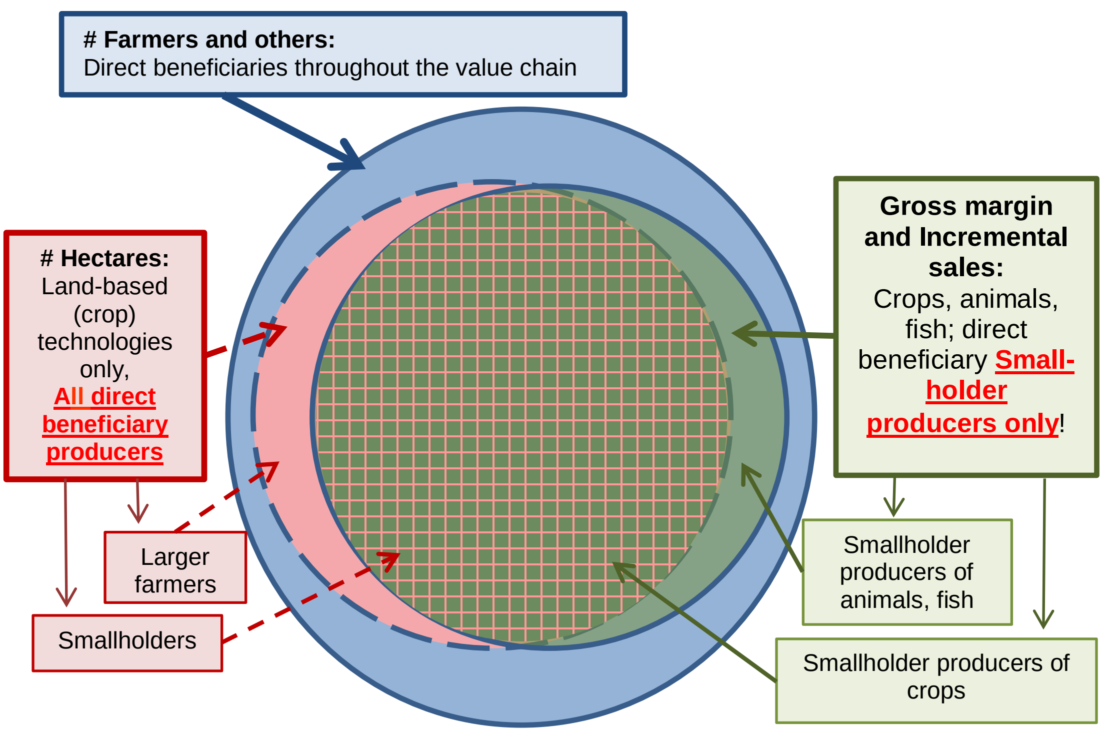
The Feed the Future list of indicators was not developed as an exhaustive list with which to monitor Feed the Future investments. ***IPs can – and should – develop custom indicators to track results relevant to their activities that are not captured by current Feed the Future indicators***.

Process of Selection. Missions and IPs are responsible for ensuring selected indicators are the most appropriate for measuring progress toward the goals and objectives of the IM, as well as to country-specific IRs and sub-IRs determined by the Mission. Indicators should not be selected that are beyond the capacity of IPs to collect, either technically or financially. Missions and IPs can negotiate for those indicators that best track progress toward results and that can be measured with available resources.

Beneficiaries

All four indicators covered in the Guide are reported for direct beneficiaries only. The types of beneficiaries covered for each indicator differ; some indicators cover a broader base of beneficiaries than other indicators (see Figure 1.)

Figure 1. Universe measured for the four key agricultural indicators



All direct beneficiary primary producers (farmers, ranchers, fisherfolk, herders), entrepreneurs, traders, processors (individuals only), natural resource managers, and others throughout the agriculture sector can be reported under the number of farmers and others applying improved technology or management practices. The number of hectares can only be reported for those primary producers that are engaged in land-based agricultural production activities that can be measured in hectares. Incremental sales and gross margin can be reported for direct beneficiary, small-holder farmers/primary producers engaged in the agriculture sector.

Identifying Beneficiaries. Beneficiaries are usually classified as either direct beneficiaries or indirect beneficiaries. ***Direct beneficiaries are those individuals within the target area that receive direct benefits (i.e., goods or services) from the activity (including where applicable, families receiving household food rations and individuals receiving individual rations).*** According to the Feed the Future Indicator Handbook, "the intervention needs to be significant, meaning that if the individual is merely contacted or touched by an activity through brief attendance at a meeting or gathering, s/he should not be counted as a [direct] beneficiary."

Indirect beneficiaries are those individuals that receive indirect benefits from the activity. For example, neighbors who see the results of the improved technologies applied by direct beneficiaries and decide to apply the technology themselves (spill-over), or the individuals who hear a radio message but don't receive any other training or counseling from the activity.

Only direct beneficiaries are measured for all four indicators covered in this Guide. Identifying control groups or measuring results on indirect beneficiaries are not required for Feed the Future performance monitoring. Thus, ***indirect beneficiaries are not counted or reported for any of the four indicators covered in this Guide.***

Farmers and others may still be direct beneficiaries in activities that work directly with input suppliers, agro-businesses, processors or through training of trainers or lead farmers rather than directly with the farmers themselves. According to the Feed the Future Indicator Handbook, "individuals and organizations that are trained by an IM as part of their service delivery strategy (e.g., cascade training) that then go on to deliver services directly to individuals or to train others to deliver services should be counted as direct beneficiaries of the activity – the capacity strengthening is key for sustainability and [an] important outcome in its own right. ***The individuals who then benefit from services or training delivered by the individuals or organizations trained or assisted by the IM are also direct beneficiaries***." In this case the IM should set targets for, measure, and report on the application of the improved technologies and management practices by both sets of direct beneficiaries. In such cases, the main challenge for IMs often lies in if/how trainers or service providers accurately track their interactions with farmers and others for reporting information correctly into FTFMS. Appropriate recordkeeping should be promoted as part of the overall project; lack of such records does not mean that farmers or others are not direct beneficiaries.

A key consideration is whether a deliberate strategy exists for direct beneficiaries to pass on what they have learned to others, for example, by being trained in effective techniques for training other community members.

For example, if an activity engages primarily with extension agents, agro-dealers, or processors, who in turn provide goods and services to farmers and others as a result of training or other assistance from Feed the Future activities, the service providers and the primary producers are considered direct beneficiaries. If a project works through extension agents who provide training to lead farmers, who then train other farmers participating in the project, the extension agents, lead farmers and participating farmers are all direct beneficiaries. If the participating farmer then passes on knowledge or technology to a non-participating farmer (e.g., a neighbor), the non-participating farmer is an indirect beneficiary, **if** the project has not conducted training of trainers with the participating farmer as a deliberate strategy to cascade training to another layer of beneficiaries. Such diffusion could be assessed as part of a future performance evaluation, but is not otherwise reported in FTFMS as part of annual monitoring activities.

Gender

Feed the Future places great emphasis on including the most economically vulnerable populations, including women, in activities that strengthen agricultural economic growth to have a transformative effect on regional economies. Feed the Future also recognizes the role of women in agriculture as being critical to increasing agricultural productivity, reducing poverty, and improving nutrition, and is therefore interested in monitoring how its benefits and services are distributed among female and male beneficiaries.[7] Feed the Future's overall M&E approach measures the effect of Feed the Future investments on women and men, and tracks progress of women's achievement relative to men's.

Three of the four indicators covered in the Guide require disaggregation by sex (i.e., male, female). The requirement relates to both technology and management practices indicators (4.5.2-2 and 4.5.2-5), and to all five data points for gross margin (4.5-16). Only the value of incremental sales (4.5.2-23) is not disaggregated by sex, as it is measured at the farm level, across all Feed the Future-attributable commodities.[8]

All data must be collected in a way that allows for reporting appropriate disaggregates. Missions must ensure harmonization among IMs and IPs regarding the collection of sex and other disaggregates. Procurement documents should include requirements on the proper collection and reporting of indicator disaggregates, in order to ensure partners provide the data required for reporting. This is particularly critical when IPs have multiple subcontractors or subgrantees.

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[7] USAID. 2012c.

[8] IPs measure incremental sales at the farm level by commodity, aggregating across all plots planted to the commodity by direct beneficiary small-holder producers. Data for incremental sales are entered into FTFMS disaggregated by commodity. FTFMS then aggregates across all commodities.

New Categories. Many IPs have raised concerns related to their inability to disaggregate certain activities by sex, for example, where direct beneficiaries of both sexes within a household are engaged in growing targeted crops on the same plot. Additional concerns were raised in regards to attributing sex ratios to groups of beneficiaries involved with certain types of group activities, for example, farmer field school demonstration plots. To address these concerns, Sex disaggregate categories were added to the gross margin (4.5-16) and the number of hectares under improved technology or management practice (4.5.2-2) indicators in the September 2013 revision of the Handbook. Neither new disaggregate category (joint, association-applied) is appropriate for the number of farmers and others applying improved technology or management practices (4.5.2-5).

The Sex disaggregate category "joint" can be used in those cases where men and women direct beneficiaries share in decision-making regarding the use of land. ***"Joint" is not applicable to situations in which a male makes the management decisions about the land and a female mainly provides labor.*** In this case, the appropriate Sex disaggregate category is "male." "Joint" is also not appropriate when a male and female share a plot of land but operate it independently, for example, during different seasons. In this case, data on area, production, sales, input costs, and application of improved technologies and management practices during each season are measured separately, and reported under the appropriate disaggregate (male or female) for gross margin (4.5-16), number of hectares under improved practices (4.5.2-2), and number of farmers applying improved practices (4.5.2-5).

"Joint" is only applicable to the gross margin (4.5-16) and number of hectares (4.5.2-2) indicators. For the number of farmers and others applying improved technologies (4.5.2-5), if land is farmed jointly by a male and female beneficiary, and improved technologies or practices are applied, both beneficiaries are counted – one male and one female.

In those cases where there are both male and female direct beneficiaries in the same household and it is not clear who manages a particular plot, it may be necessary to question both regarding who makes the decision(s) on what to plant and how, when to harvest, which inputs to purchase, and how to use them (Appendix 2). The "joint" Sex disaggregate category focuses on decision-making regarding management of the plot, pond, or livestock rather than use of income from production because the indicators to which it applies measure "what was done to the plot" as opposed to "what was done with the income generated from the plot." ***It is not necessary to determine who has decision-making responsibility for all beneficiaries, only in those cases where it may not be clear how to tease apart who should be considered the "farmer" for purposes of the sex disaggregation.***

The second new Sex disaggregate category[9], ***"association-applied," should be used in cases where a group or an association of direct beneficiaries is jointly cultivating a plot, or managing livestock or aquaculture as a group.*** For example, a group of farmers applies an

[9] The "association-applied" disaggregate is only new for gross margin (4.5-16); it already existed for hectares under improved technology or practices (4.5.2-2).

improved fertilizer formulation on a demonstration plot. In this case, the hectares are counted as "association-applied" under the number of hectares under improved technologies (4.5.2-2) and gross margin (4.5-16). The farmers are counted as one group under Feed the Future's indicator referring to groups[10] (4.5.2-42).

These and other disaggregates are discussed in greater detail under the respective indicator in the section titled *Understanding the Indicators.*

Data Collection

This section discusses general issues regarding how, where, and when data are collected.

Sources. The easiest and often least expensive way of obtaining agricultural production data is to simply ask farmers and other producers directly. Producer association records are another possible source of such data, particularly when dealing with a large number of producers. Under some circumstances, however, producers may conduct transactions above and beyond those with an association (e.g., side sales). Thus, producer records (when kept) may differ from group records (e.g., associations, cooperatives [co-ops]). For example, dairy producer sales records from dairy co-ops may not reflect dairy producers' sales to their neighbors or other buyers if they "dump" milk of lesser quality or are unable to get it to the co-op in a timely fashion. Each data source may only reflect a subsample of sales recorded in the other, and teasing out possible duplicate records may be difficult. Ideally, IPs need to understand why/how the two types of records differ before being able to determine which might be a more accurate source than the other, or whether they might be combined.

Farmer Recall. Small farmers often keep no records and much information collected about agricultural production activities depends on farmer recall. Many IPs raised concerns about the validity of farmer recall data, even when employed as their primary means of data collection. While it has long been believed that farmer recall is not reliable and that the errors in recall increase with time from the event (e.g., harvest, sale, purchase of inputs), recent evidence calls this assumption into question. However, data collection timed to the event improves accuracy, and thus, reliability of farmer recall.

For some data, planning the best time for data collection may be fairly straightforward (e.g., to collect data on area cultivated, production), though it may still be spread out in time if multiple crop cycles are possible or if harvest takes place over an extended period. For other types of data, the best time for collection may be less straightforward. For example, some farmers may sell all or most of their entire crop right after harvest while others may make periodic sales throughout the reporting year, as prices improve (especially if they have access to good storage facilities). Reducing the time

[10] 4.5.2-42 Number of private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBO) that applied improved technologies or management practices as a result of USG assistance.

between periodic events (e.g., sales) and when farmers are asked about the event could be accomplished by combining routine monitoring activities (e.g., field visits from extension agents and other staff) with data collection at regular intervals (e.g., monthly, quarterly).

Though not required by Feed the Future, multiple data collection efforts throughout the reporting year – where feasible – may provide the most accurate data from farmer recall: area planted and input costs might be collected at the start of a crop cycle or soon after planting; input costs, production and sales of crops with extended harvests (e.g., banana, cassava) might be collected periodically (e.g., quarterly); and input, production and sales data might be collected at harvest or soon thereafter. This will not be possible for many cases, but is a valid strategy for IPs to consider, where feasible.

Collecting Data. Routine monitoring and a wide range of methods for collecting data on the indicators were reported during the consultation phase, including key informant interviews and focus groups (e.g., farmers' associations), which are not appropriate for quantifying Feed the Future annual performance monitoring indicators.[11] IPs also reported using acceptable ways of collecting data on annual performance monitoring indicators, including taking a census of all beneficiaries, surveying randomly drawn samples of beneficiaries, and using routine monitoring systems.

Data can be collected through agricultural extension agents, association records, lead farmers, or external consultants. Many IPs report using routine monitoring records collected on a monthly, or more typically, on a quarterly basis.

There is no single requirement for how data should be collected. IPs may use annual beneficiary-based census or surveys, routine monitoring records, or a combination of both.

Sampling. The goal of sampling is "to reduce the cost of collecting data about a population by gathering information from a subset instead of the entire population."[12] Detailed discussion of sampling issues, including sampling frames, sample size, level of precision needed, etc. are beyond the scope of the Guide. Detailed instructions on sampling for direct beneficiary surveys will be provided in an upcoming Feed the Future Beneficiary-Based Sampling Guide that will be available in late 2015. In the meantime, sampling guidance is provided in Magnani[13] and subsequent updates,[14] as well as in the United Nations' guide on designing survey samples.[15] Resources for calculating sample size are also available online, such as The Survey System (www.surveysystem.com) and Raosoft (www.raosoft.com). Although sampling for annual beneficiary-based surveys involves the same

[11] However, qualitative approaches help contextualize and clarify quantitative findings, providing depth and richness to interpretation. Feed the Future encourages use of mixed methods as a cross-cutting M&E best practice for annual performance monitoring, and performance and impact evaluations. Qualitative approaches should be integrated as a routine component of Activity M&E Plans.

[12] Magnani. 1997.

[13] Ibid.

[14] Stukel and Deitchler. 2012.

[15] United Nations. 2005.

general considerations as sampling for population-based baselines and endlines, there are important differences. For example, annual performance indicators are not typically analyzed for statistically significant differences over time, which often requires larger sample sizes than might be necessary for robust point-in-time estimates. In addition, many annual performance indicators report totals across all beneficiaries, as opposed to means or prevalences.

Extrapolating Data. ***When data are collected from a sample of the total beneficiary population (e.g., from a beneficiary-based survey), results must be extrapolated to the total beneficiary population level for the reporting year before entering into the FTFMS.*** Detailed instructions on extrapolating data are presented in Appendix 3.

Measurement Challenges

Challenges regarding the collection and use of the four agricultural indicators discussed in the Guide center on two basic issues:

- Methodological challenges to collecting the required data, and
- Lack of clear understanding of current definitions and guidance.

This section addresses methodological issues related to collecting indicator data. These include challenges resulting from intercropping, and challenges associated with measuring area, production, technology and management practices, sales volume and value, and agricultural input costs. Each subsection discusses the issues, followed by specific suggestions/solutions for addressing them. Issues related to better understanding of the four indicators are discussed in the section on *Understanding the Indicators*, in which issues specific to each indicator are discussed. Within each subsection, a general discussion of each indicator (e.g., what is measured, FTFMS reporting, interpretation of data) is followed by specific suggestions/solutions for addressing indicator-specific issues. Additional analysis that ***could*** be undertaken by IPs to enhance interpretation of performance monitoring results for each indicator is discussed in Appendix 4.

Measuring Intercrops

Intercropping refers to the cultivation of more than one type of crop on the same piece of land during the same crop cycle.[16] There are many different types of intercrop arrangements but they are generally classified into two categories:

- Spatial distribution, and
- Temporal distribution.

Spatial Distribution. Spatial distribution of intercrops is determined by how the individual crops are distributed relative to each other within the plot or field. Intercrops can be additive, in which the primary crop is planted at its "typical" spacing (i.e., recommended density) and the secondary crop is "added" on top of that. Alternatively, and perhaps more commonly, intercrops can be substitutive, where the secondary crop is substituted for some portion of the primary crop in its "typical" planting arrangement. Figure 2 is illustrative of spatial distributions found in intercrops.

[16] Andrews and Kassam. 1983.

Figure 2. Spatial distributions of intercrops

a) Sole crop: typical arrangement for primary crop (X)

X	X	X	X	X
X	X	X	X	X
X	X	X	X	X
X	X	X	X	X
X	X	X	X	X

b) Substitutive: rows of secondary crop (O) are substituted for rows of (X)

X	O	X	O	X
X	O	X	O	X
X	O	X	O	X
X	O	X	O	X
X	O	X	O	X

c) Additive: rows of secondary crop (O) are added to a plot of (X)

X	O	X	O	X	O	X	O	X
X	O	X	O	X	O	X	O	X
X	O	X	O	X	O	X	O	X
X	O	X	O	X	O	X	O	X
X	O	X	O	X	O	X	O	X

However, tremendous variation exists for each of these basic patterns. Primary and secondary crops may alternate within a row; primary and secondary crops may alternate every other row (see Figure 2b); there may be several rows of the primary crop to one row of the secondary crop; or blocks of the primary crop (e.g., six rows) to blocks of the secondary crop (e.g., six rows). The larger the block of any individual crop, the more "sole crop"[17] it becomes.

Temporal Distribution. Intercrops can be planted at the same time (simultaneous planting) or a second crop planted at some point during the life cycle of the initially planted crop. By staggering planting times, this technique helps ensure that competition for resources (e.g., water, light, soil nutrients) between the two crops is reduced or eliminated.

Measurements of area are required for calculating gross margin and hectares under improved technology or management practices. How the area of each crop type grown under intercropping is measured depends primarily on the spatial arrangements of the crops. Details for measuring the relevant data points when intercropping is used as a production system are presented in the respective measurement challenge sections.

Measuring Agricultural Area

Measures of area are fundamental components of agricultural statistics, as they are required for calculating many indicators of productivity including gross margin and agricultural yields (total production divided by the area used to produce it results in estimates of yield per unit of area).[18] Ideally, measures of both production and area should be highly accurate. However, errors in the denominator (area) magnify any errors in the numerator (production); thus, accurate measures of area are arguably more critical to minimizing potential errors in calculating agricultural yield, as well as Feed the Future-required indicators such as gross margin. As many farmers in developing countries have no real means of accurately determining how much land they use to produce crops or other agricultural products, accurate measures of area can be difficult to obtain.

Two of the four indicators covered in this Guide require measurement of the area under production. For gross margin (4.5-16), the area under crop or pond aquaculture production is measured in

[17] "Sole crop" is used here to refer to a single crop grown in a plot in a given year. In contrast, "monocrop" refers to a single crop grown year after year on the same land without rotating with other crops.

[18] Although yield per se is not required for Feed the Future reporting, its components are reported under gross margin and could be used to calculate a custom indicator on yield.

hectares. Hectares are also used to measure land-based technologies or practices under the improved technologies indicator (4.5.2-2).

There are a number of valid methods for measuring area under production, each with its own set of pros and cons, degree of accuracy, and associated costs. There is no single method that will be best for all circumstances; rather, there is a range of acceptable approaches to collect valid data. ***In collaboration with the relevant USG agency, Feed the Future IPs should select the best methodology for collecting data based on an assessment of the trade-offs between accuracy, cost, budget and available resources.*** Regardless of the method used to collect the data, as long as what is being collected is the same (e.g., land/pond area under production) and all data are accurately converted to standardized units (e.g., hectares), it is possible to compare or aggregate commodity-specific gross margin results across different types of projects.

Area Planted vs. Area Harvested. The relevant measure for area is the area planted (cultivated), rather than the area harvested, or owned. This is an important distinction since not all parts of a field or farm that are planted will necessarily produce any yield or be harvested. Although whole farm measurements may be needed for other purposes, they are not required for any of the indicators discussed in the Guide.

The area from which crops are harvested is not necessarily the same as the area in which crops are planted. For example, parts of a plot or field can be washed out through heavy rains and flooding, left barren from drought, or heavily damaged from insects or browsing animals. Stand establishment (and ultimately what is harvested) may vary across a plot or field due to differences in germination and soil water holding capacity resulting from differences in soil structure and level of organic matter (e.g., sandy spots, rocky areas). To accurately calculate gross margin, the area planted, and on which inputs would have been used, needs to be measured regardless of how much of that area was ultimately harvested.

1. Methods for Measuring Agricultural Area

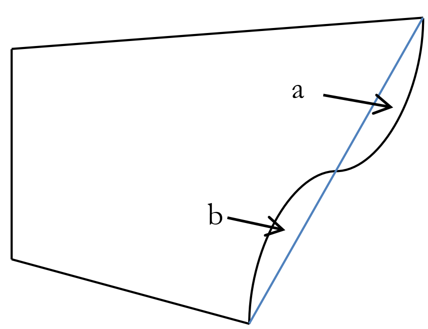
There are two main approaches to measuring agricultural area: direct measurement and estimation. Direct measurement involves physical measurement of the area(s) actually planted to a particular crop. For fish produced through aquaculture, the surface area of the pond(s) in which the fish are spawned is measured. Area of production can be estimated either by "experts" or farmers, though accuracy of farmer estimates vary widely (discussed in more detail below in *Farmer Estimates*). Direct measurement is the most accurate way of collecting data on area cultivated, but may not be practical in certain circumstances (e.g., large numbers of direct beneficiaries).

Direct Measurement. For both the gross margin (4.5-16) and hectares under improved technologies or management practices (4.5.2-2) indicators, the level of measurement is farmers' plots – not necessarily their entire fields. A plot is considered to be a single piece of land on which a particular crop is grown. Thus, a farmers' field may have several plots – each of which is growing only one crop type or mixed cropping system. In this case, each "crop-plot combination" would be measured separately. Measurements of noncontiguous plots of the ***same*** crop should be added together.

Ideally, measurement of land area should take place soon after planting, perhaps combined with data collection on farmer inputs, which is often conducted early in the crop cycle while costs associated with input purchases are relatively fresh in the mind of most farmers. [19]

Tape and Compass. Use of a measuring tape and compass to measure area provides a relatively inexpensive, accessible, and easy-to-use methodology that is applicable in most circumstances.[20, 21] Using this approach, the sides of a plot are measured, and the angles of the corners determined to calculate total area of the polygon. ***The Polygon Method*** is particularly useful for irregularly shaped plots or those with curved sides. In these instances, estimations of a straight-lined side to the polygon must be made, with care given to balancing any plot area that now falls outside of the polygon (a) with that from nonplot area that now falls within the polygon (b) (Figure 3). In this instance, the area of the plot can be estimated as a regular four-sided polygon. This same method can be used for other irregularly shaped plots as long as the amount of land that is excluded by the polygon is roughly equivalent to the amount of non-plot land that is included.

Figure 3. Straight-line estimation of plots



Adapted from Diskin 1999

Plots with irregular shapes may need to be divided into multiple polygons.[22] Using tapes and a compass, several approaches can be utilized to calculate the area of irregularly shaped plots, the choice of which may vary on the shape and size of the plot itself. In the Polygon Method described above, the length of each side of the polygon is measured with the tape and the angles of each corner are measured with the compass. The area of the plot is then calculated mathematically. Free, web-based programs to calculate area such as SketchandCalc™ (www.sketchandcalc.com) are widely available. AutoSketch (www.autodesk.com) and other programs are available for purchase, but can be expensive. Google Earth

[19] Since inputs (e.g., pesticides, labor for weeding) may be purchased throughout the crop cycle, costs could be measured through multiple data collection events (e.g., routine monitoring) throughout the reporting year.

[20] Fermont and Benson. 2011.

[21] de Groote and Traoré. 2005.

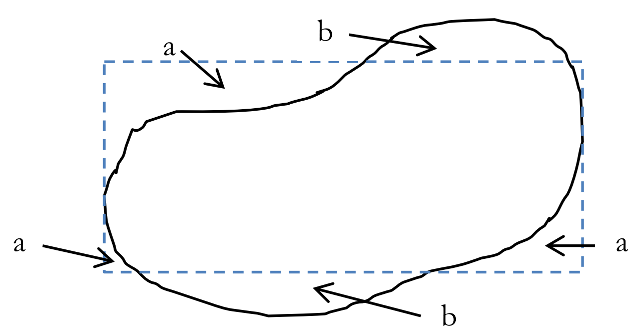
[22] FAO. 1982.

Pro makes direct calculations of area, as long as the plot can be identified from satellite images provided through the program, which is often difficult but not impossible. Inaccuracies in measurement of the polygon can lead to closing errors, i.e., the sides of the polygon do not completely close, leaving a gap when plotted. Detailed instructions of this methodology and strategies for dealing with closing errors are available.[23, 24, 25]

In addition to the Polygon Method described above, crop area can be measured though ***rectangulation and triangulation.*** This involves first dividing the plot into rectangles and triangles, and subsequently measuring the length and width of the rectangles as well as the height and base of the triangles.[26] The plot area is the sum of the area of all rectangles and triangles. Appendix 5 presents formulas for calculating area of various shapes. This approach may be less appropriate for measuring crop area for high-stature crops (e.g., maize, sorghum, millet), where it might be difficult to visualize rectangles and triangles on the ground.[27] Thus, it is recommended to measure area cultivated soon after planting, when the crops are still short enough to easily see over.

Measuring the surface area of irregularly shaped ponds (Figure 4) used for aquaculture can be difficult. In this case, estimation can approximate the pond shape as a rectangle, square, or circle by measuring along boundary lines that most accurately follow the shoreline. As above, it is important to try and balance the non-pond area to be included in the calculation (a) with the pond area that now lies outside the boundaries (b).

Figure 4. Estimating pond area[28]



Though relatively low cost, measuring tapes and compasses should be high quality to minimize errors in precision and accuracy that could occur from use of subpar instrumentation. Thus, costs associated with using tapes and compasses may be similar overall to those associated with handheld

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23 Diskin. 1999.

24 Casley and Kumar. 1988.

25 FAO. 1982.

26 Fermont and Benson. 2011.

27 Muwanga-Zake. 1985.

28 Adapted from Norland, E. [No date] Pond Measurements. Ohio State University Fact Sheet. Accessed online June 7, 2013 at: http://ohioline.osu.edu/a-fact/0002.html.

Global Positioning Systems (GPS) units, depending on both the number and sizes of plots being measured. As noted in a report of a pretest on measuring area using tapes and compasses in Uganda, enumerators must be well-trained in the use of compasses (e.g., distinguishing backward/forward bearings, linking bearings to the appropriate segment of length) to minimize potential closing errors.[29] Other costs (e.g., training costs for enumerators) beyond those for quality instruments need to be considered to determine the relative cost/benefits of this and other methodologies.

GPS. With increasing affordability of handheld GPS units over the last decade, GPS has emerged as a potentially viable option for measuring area in development programs. GPS units map locations on the earth's surface by continuously determining latitude, longitude, and elevation using at least three satellites within the GPS satellite network.[30, 31] The average unit is accurate to within approximately +/- 10-12 meters[32] (5-6 meter radius from displayed position). Unfortunately, this is problematic for small plots; ***on average, the tape and compass approach produces more accurate results than GPS for plots smaller than 0.5 hectare (ha)***.[33] Berger and Dunbar,[34] who compared the accuracy of both systems in measuring perimeter points, explain that for each point recorded, the maximum error is proportional to the distance measured when using tapes and compasses but it is constant and additive using GPS. Thus, there is a point at which the accumulated errors associated with tapes and compasses surpass those associated with GPS; the tape and compass approach is more appropriate for smaller plot sizes and distances while GPS is more accurate for plot sizes over 0.5 ha and longer distances.[35]

The accuracy of using GPS to measure area is also affected by atmospheric conditions (e.g., sunny, cloudy), the number of satellites visible to the handheld unit, dense foliage, the slope of the plot, buildings, electronic interference, how close or clustered the satellites are to each other, reflected signals, the quality of the GPS unit itself and more .[36, 37] Thus, while promising as a possible technique for easily capturing fairly accurate data on area, GPS measurements may not be appropriate for all circumstances.

Keita et al.[38] provide an excellent summary of issues regarding use of GPS and Personal Digital Assistants (PDAs) for measuring area. Given the relatively recent emergence of and constant

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29 Apuuli et al. 2002.

30 Fermont and Benson 2011.

31 Keita et al. 2010.

32 Newer GPS models with improved antennae may provide better resolution but will still have a margin of error that should be considered when measuring small plots.

33 Fermont and Benson. 2011.

34 Berger and Dunbar. 2006.

35 Ibid.

36 Schøning et al. 2005.

37 Keita et al. 2010.

38 Ibid.

improvements in GPS and other technologies, guidance on crop area measurement with GPS and PDAs, as well as their use for linking with other layers of data in Geographic Information Systems (GIS) is under development by FAO, World Food Programme (WFP), and the Joint Research Centre of the European Union.[39]

Pacing. Arguably one of the least expensive methodologies for estimating area, pacing has been widely used in many developing countries where farmers have little or no skills or knowledge regarding land area measurement and little or no access to the equipment needed for its measurement.[40] Pacing involves the use of an individual's pace (i.e., the length of their step while walking) as the measuring device (e.g., the pace replaces a tape). Pacing can be used with any of the above approaches for calculating area (e.g., rectangulation, polygon).

The pacer's steps (e.g., of an enumerator) should be standardized to minimize variation in the length of the step, particularly over uneven ground or varying slope, and recalibrated periodically over the course of the season.[41] The number of paces are then counted and converted to standardized units. Accuracy of pacing requires that enumerators walk at a regular, normal walking gait, which can be difficult to maintain. An average pace can be calculated using the number of paces for an area of known perimeter (directly measured).

Farmer Estimates. Area is often determined by farmer estimates of how much area they cultivate (or of their entire holdings) through both surveys and annual monitoring activities. Historically, farmer estimates of area were not considered highly accurate.[42] However, more recent evidence both refutes this assumption and shows how reported "inaccuracies" might arise. For example:

- Farmer estimates of surface area were found to be in fact quite accurate,[43]
- Small farmers tended to overestimate area while larger farmers tended to underestimate,[44]
- Accuracy of farmer estimates was reported to decrease with increasing plot size,[45, 46] and
- Accuracy of farmer estimates for area vary with their level of familiarity with area measurement units.[47]

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39 Ibid.

40 Ibid.

41 Mpyisi. 2002b.

42 FAO. 1982.

43 David. 1978.

44 De Goote and Traorè. 2005.

45 Ibid.

46 Ajayi and Waibel. 2000.

47 Verma et al. 1988.

Thus, the evidence suggests that ***farmer estimates may be quite accurate, at least in some circumstances.*** The accuracy of farmer estimates may be improved by comparing farmer estimates with direct measurements for a sample of beneficiary farmers and calculating a correction factor. For example, if data are collected through a sample survey of direct beneficiary farmers, all farmers in the sample are interviewed and their estimates of area recorded. Then, a subsample of these farmers is selected and their fields physically measured with tapes and compass to provide a direct measurement of their individual field(s). Regression analysis is then conducted to determine if or how much of a correlation exists between the two measurements (farmer estimates and physical measurements of area as the independent and dependent variables, respectively). This correction factor can then be applied to farmer estimates of area for the rest of the beneficiary farmer population. Correlations between farmer estimates and direct measurement have ranged from 0.7 to 0.95.[48]

Many small-holder farmers may calculate area based on local units, including the time needed to work a piece of land. Although the units are usually standardized in some way, the scope for subjective error is large. Farmers do not always need (or take) the same amount of time to do a given piece of work, or have the same measure of area per unit of time. In such cases, it may be possible to sample units and determine an appropriate conversion factor between time worked and area. Otherwise, it may be best to directly measure area rather than attempt to convert estimates based on the time required to complete specific tasks. When using farmer estimates, be clear about the units used by the farmer and if/how they can be accurately converted to hectares.

Remote Sensing. Though potentially promising as a technique for capturing accurate measures of area, use of remote sensing remains problematic for most development projects.[49] Remote sensing involves using satellite imagery to detect and analyze objects based on electromagnetic energy and may be a viable option for estimating land area at the county, regional, or country levels where estimates of large unobstructed areas are reasonably reliable and accurate. Projects involving large-scale irrigation infrastructure may lend themselves to use of remote sensing, but its widespread application is limited overall by small field or plot sizes, varied crop planting dates, interspersion of perennial trees within fields, intercropping, and the need for specialized equipment and skills.

Summary. Table 1 summarizes each measurement or estimation technique with comparison across the variety of dimensions discussed above.

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48 Fermont and Benson. 2011.

49 Ibid.

Table 1. Comparison of techniques for measuring area

	Accuracy	Cost	Equipment required	Expertise needed	Level of effort	Plot size
Tape and compass	medium-high	medium; varies with quality	low	low-medium	medium-high	< .5 ha
GPS	high	med-high; varies with quality	high	medium	medium	> .5 ha
Pacing	low-medium	low	low	low	medium	small-medium
Farmer estimates	low-medium; high w/correction factor	low	low	low	low	small
Remote sensing	low	high	high	high	medium	very large

2. Intercrops

Measuring the land area for each crop in an intercrop system can be challenging, depending on the intercrop arrangement. For substitutive patterns (i.e., one crop substitutes for some portion of the primary crop), the total area is measured and the area under each crop is calculated as its relative proportion of the total, regardless of the specific pattern of substitution. For example, if the secondary crop makes up 50 percent of the total plot, whether in alternating rows, alternating blocks, or some other arrangement, then the total area under each crop is one-half of the total measured area. If the secondary crop constitutes one-fourth of the primary crop (e.g., one row of secondary crop to three rows of primary crop), then areas are 75 percent and 25 percent of the total area for the primary and secondary crops, respectively. The sum of the area for each intercrop should equal the total area measured.

Bean Game

To understand the relative allocation of space for each crop in an intercrop, Feed the Future beneficiaries in Mozambique are asked to apportion beans or other small objects according to the estimated area of the plot each occupies. Beans (50) are provided to participants and divided into piles representing how much of the plot is planted to that crop.

For additive arrangements, the calculations are slightly more complicated. For all additive intercrop arrangements, the area of the primary crop is measured as the total area planted. Remember this is because in an additive intercrop, the primary crop is planted at its recommended density, and is therefore measured as the total area planted. The intercrop pattern is considered additive if another crop is then added above and beyond the normal planting arrangement for the primary crop. Area of the secondary crop is calculated as the proportion of the total area. If the primary crop is grown in an additive intercrop, but its area is proportionally allocated based on its spatial relationship to the secondary crop (e.g., five out of nine rows rather than five out of five rows), the reported area of the primary crop will be underestimated (56 percent rather than 100 percent of the total plot area), resulting in an overestimation of the reported gross margin for the primary crop.

For example, in Figure 2a (page 13) we see that the "typical" spatial arrangement for primary crop (X) involves five rows. This represents the recommended spatial arrangement at which primary crop (X) should be cultivated. In Figure 2c, we see that four rows of secondary crop (O) have been added to the plot of primary crop (X) (five rows). As an additive intercrop arrangement, the area of production for primary crop (X) is 100 percent of the total plot area (i.e., the primary crop is cultivated at its recommended density and hence "occupies" the entire area) and the area for the secondary crop (O) is 44 percent of the total area measured (four out of nine rows). If the area of the plot is 1 hectare, then the reported land area is 1 hectare for the primary crop (X) and .44 hectares for the secondary crop (O). As the commodities are reported separately, the fact that the sum of the proportions is greater than 1 is of no concern.

If only the primary crop (X) is counted and reported (i.e., the secondary crop is not a Feed the Future value chain commodity), area should be calculated as:

- A proportion of the total area if grown in a substitutive arrangement; and
- Total area if grown in an additive arrangement.

If only the secondary crop (O) is counted and reported (i.e., the primary crop is not a Feed the Future value chain commodity), the area should be calculated as a proportion of the total area regardless of whether grown in a substitutive or additive arrangement.

3. Specific Challenges Measuring Agricultural Area

Suggestions for and solutions to specific challenges related to measuring area are presented below.

Problem	Response
How should area be measured for small plots/many plots?	Plots < 0.5 hectare should be measured with tapes and compass or pacing, using the polygon, rectangulation, triangulation, or P^2/A methods for calculating area. Farmer (and expert) estimates may also be employed; their accuracy can be increased through verification with direct measurement and calculation of a correction factor based on the correlation between the estimates and direct measurements.

Problem	Response
How should area be measured for intercropping systems?	For gross margin (4.5-16), proportionally estimate or measure the area planted for both the primary and secondary crops in substitutive arrangements and the secondary crop in additive arrangements; use the total area for the primary crop in additive arrangements. *[See 2. Intercrops]* For number of hectares (4.5.2-2), if a technology or practice is applied to all target intercropped crops or to a primary target crop in an additive intercrop arrangement, the total area is reported. If a technology or practice is applied to only one of the target intercrops in a substitutive arrangement or to the target secondary crop in an additive arrangement, proportionally estimate or measure the area on which the technology or practice is applied. If intercropping is the improved practice being promoted, measure the total area under cultivation.
How should cultivated area be counted for multiple cropping cycles in one reporting year?	For gross margin (4.5-16), the area planted is reported each time it is cultivated with a target crop during the reporting year. For example, if a farmer cultivates a one hectare plot three times with the *same* target crop during the reporting year, the area of the plot is counted each time and reported as a sum (i.e., three hectares under the targeted crop disaggregate). If a farmer cultivates the plot three times within a reporting year but with *different* target crops each time, the area of the plot is reported separately for each crop (i.e., one hectare under each of the three targeted crop disaggregates). For number of hectares (4.5.2-2), the area planted is counted each time it is cultivated with one or more improved technologies or practices during the reporting year. For example, if a farmer cultivates a one hectare plot three times in the reporting year and applies an improved technology or practice to the plot each time it is cultivated, the area of the plot is counted each time and reported as a sum (i.e., three hectares under improved technologies or practices).
How is area measured if beneficiaries don't own the land on which they're producing crops (e.g., government-owned, rented, sharecropped)?	Ownership is not an issue for collecting this data; the area on which farmers cultivate target crops is counted regardless of land tenure.
How is the area of a pond measured?	For aquaculture products, a pond is measured according to its surface area, and is therefore measured in the same way as a plot of land.
How are the dykes around pond areas dealt with if being used to grow crops?	Area should be measured as a small plot.
Would it be acceptable to use data collected in collaboration with the Ministry of Agriculture (MOA) in order to ensure consistency with official data?	Collaborating with MOAs or other specialized data collection entities is acceptable as long as the data collection method and the accuracy of the data are known and acceptable to the Mission and IP(s).

Problem	Response
Can expert estimates (e.g., extension agents, agronomists) be used? If so, should their estimates be cross-checked?	Experts such as extension agents and others who are experienced at estimating area may provide accurate "measures" of area. Often, there simply are not enough experts with the required experience to make this a viable option. In addition, IPs must be sure no incentives to overestimate area exist, for example, when an extension agent's job performance is judged based on the area under an improved technology s/he is tasked with promoting. Expert estimates can be verified with direct measurements as described above under "Farmer Estimates."
Can cultivated area be measured with a rope, ribbons and stakes?	Any standardised objective measuring tool – including tape measure or rope/ribbons/stakes that have been marked off using a tape measure – can be used and is generally more accurate than a subjective measure, such as pacing.
Is there a maximum level of acceptable error for estimates?	Neither Feed the Future nor Food For Peace (FFP) require extremely precise estimates for the purposes of annual monitoring of these indicators. Acceptable margin of error is often driven by the sample size allowed by your budget. A reasonable level of error is approximately 5 -10 percent.
How are irregularly shaped plots measured?	Depending on available resources and the size of the plots, the polygon method, rectangulation, or triangulation can be used in conjunction with tapes/compass, pacing or GPS.
How does plant density affect measures of area?	Plant density does not affect measurement of area for either gross margin (4.5-16) or number of hectares (4.5.2-2).
How are large noncultivable areas of a field or plot (e.g., anthills, large rocky outcrops, piles of rocks) accounted for?	Estimate or measure the area left out of production and reduce the total area accordingly.

Measuring Agricultural Production

Both gross margin (4.5-16) and value of incremental sales (4.5.2-23) require data on agricultural production, specifically, the total amount of crops, livestock products, or fisheries products that was produced as a result of USG assistance. For most of this section, discussion will center on crops. However, every effort will be made to include appropriate and relevant mention of livestock and fisheries issues.

There is a wide variety of acceptable methods for measuring crop production, each with its own set of pros and cons, degree of accuracy, and associated costs. Similarly, there is no one method that best suits all circumstances; rather, there is a range of acceptable approaches to collect valid data. ***In consultation with USAID, Feed the Future IPs should select the best methodology for their program(s) based on an assessment of the trade-offs between accuracy, cost, budget, and available resources.***

Measuring Unit and Form. A number of measurement units might be appropriate for measuring agricultural production, depending on the product (e.g., liters, kilograms, metric tons). It is important to ensure that total production and total quantity of sales data are converted to the same units of measure in order to accurately calculate the total value of production for gross margin. In addition, because volume of sales is reported as metric tons under the incremental sales indicator (4.5.2-23), units of sales volume may need to be converted to metric tons before data entry for incremental sales into FTFMS. For example, if milk production and sales volume are reported under gross margin as liters of milk, before entry into FTFMS under incremental sales, the number of liters of milk sold will need to be converted to metric tons by multiplying by .001 (1,000 liter = 1 liter).[50]

A single crop can provide multiple products. For example, peanuts may be sold as either shelled or unshelled, and perhaps the shells sold as fodder for animals. Maize is typically grown for the dried grain but farmers may also grind it into flour prior to sale or sell the dried stalk and vegetative material as fodder for animals. The empty peanut shells and maize stalks represent byproducts of the primary crops peanuts and maize, respectively. The flour represents a value-added product; it is the primary product in a different form.

To value production for the gross margin indicator (4.5-16), the units of measure and form of production must be standardized with the unit of measure and form of product sold. In other words, a unit value derived from dividing the value sold by the volume sold of ***shelled*** peanuts could not be used to value the total production of ***unshelled*** peanuts (i.e., the form produced). Thus, for gross margin, the form sold and the form produced must be in the same units and form (e.g., the volume of shelled peanuts sold is converted to its unshelled equivalent). Sales of byproducts and value-added products are reported under incremental sales as part of farm-level sales of the commodity. Only value-added product sales (e.g., maize flour) are included with primary product sales and reported under gross margin. Additional discussion regarding sales of byproducts and value-added products is presented in *Measuring agricultural sales.*

Dry Weight vs. Fresh Weight. The measure of production for many crop commodities is dry weight (kilogram or metric ton). Every effort should be made to determine that crops are at full maturity and fully dry when harvested and weighed. Seed moisture content is very difficult to accurately determine with non-destructive methods, and to standardize in the absence of a temperature- and humidity-controlled environment. Farmers are typically sufficiently aware of how "dry" crops should be for harvesting as the quality of seed (e.g., grain, pulses), fruit or vegetable can be affected by harvesting too early or too late.

However, certain commodities are measured as fresh weight, that is, the weight of the fresh produce at harvest, rather than dried. For example, green beans, fresh cowpeas, tomatoes, peppers, onion, etc. should be measured as fresh weight rather than dry weight. Production (as well as volume of

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[50] This formula is for converting a liter of water to metric tons. However, the density of milk differs from the density of water, and varies relative to a number of factors (e.g., fat content, temperature). For milk at a density of 1035 kg/m^3 and temperature of 15^{o}C, 966 liters equals 1 metric ton. See: http://www.thecalculatorsite.com/conversions/common/liters-to-metric-tons.php.

sales) should be measured and reported in the same way for each reporting cycle (i.e., either as dry or fresh weight).

1. Methods for Measuring Agricultural Production

Whole-Plot Harvest. This method involves harvesting an entire plot or field and directly measuring the amount produced. As such, it is perhaps the most accurate way to measure production.[51] However, it is time-consuming, labor intensive, and impractical on a large scale. It presents challenges relative to the timing of harvests and the ability of enumerators to either participate in or be present for farmers' harvests. Thus, it is most typically used for detailed farm surveys, on-farm trials, demonstration plots, or for small-scale "case study" types of investigations.[52] Whole plot harvests are appropriate for crops with synchronous maturity (i.e., they mature at the same time) that can be harvested all at once, but are difficult for crops whose harvests are staggered in time over the course of the season (e.g., bananas, cassava, indeterminate legumes). For aquaculture, this would involve harvesting the entire aquaculture production area, such as a pond or tank, if feasible, as well as for open water aquaculture products (in cages). Only fish that are harvested are included in production estimates, although some fish may remain in the pond after the final harvest.

Crop Cuts. Use of crop cuts to calculate yield (production/area) involves sampling of subplots within a field and was once considered the gold standard.[53] Crop cuts can be accomplished in a number of ways: harvesting from a central plot within the field or from one or more subplots distributed randomly throughout the field.[54] Yield is then calculated as the total production of the cut area divided by the total harvested area of the crop cut(s). This measurement is typically calculated as kilograms/square meter (kg/m^2), which must then be converted to metric tons/ hectares (mt/ha) and subsequently multiplied by hectares cultivated to arrive at total production.

Using crop cuts (and whole plot harvests) requires establishing certain harvest protocols, regardless of whether cuts are conducted in one central or several subplots within the field. Before harvesting, agreement must be reached on exactly what can be considered "harvestable."[55] For example, whether the harvested unit is unfilled or immature, disease-infected (e.g., smut-infested cobs or cereal heads), etc. Such challenges also exist for whole plot harvests.

Given the variability inherent in most farmers' fields, harvesting of crop cuts from at least three (preferably more) randomly-selected subplots increases accuracy of the yield estimate. Multiple crop cuts reduces upward or downward bias by increasing the likelihood that variability in yield as expressed across a field is accurately captured.

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[51] Fermont and Benson. 2011.

[52] Ibid.

[53] FAO. 1982.

[54] Fermont and Benson. 2011.

[55] Ibid.

Crop cuts are time and labor-intensive. For large sample sizes or surveys, a clustered sampling technique can help reduce time and cost associated with crop cuts, but introduces additional sampling error.[56] Though crop cuts were once thought to provide accurate measures of yield, evidence suggests that crop cuts might result in rather significant biases (consistent under- or over-estimations) and may not be appropriate for small, irregularly-shaped fields and/or fields with uneven plant density.[57] When using crop cuts to estimate production, it is important that the total area cultivated be accurately measured as any errors in the denominator (i.e., area) magnify any errors in the numerator. On the other hand, if done well (e.g., sufficient time and resources to conduct accurate measurements), crop cuts can provide quite accurate data for estimating total production, particularly if direct measurements of total area cultivated are used rather than farmer estimates.

Number of Harvest Units. Total production can be calculated by measuring via direct count or recall the number of harvested units (e.g., sacks, bundles, baskets, pails) produced by a farmer from his/her field or plot.[58] If not previously standardized, a sample of harvested units are randomly selected and weighed, resulting in an average weight per unit. To determine total production, units are then counted, directly or via farmer recall, and the number multiplied by the average weight of a unit. This method allows for great flexibility in the unit of harvest as it is determined for each farmer individually. However, it is important that each farmer's harvest units can be accurately converted to kilograms or metric tons. This is an efficient method for calculating production from very large plots, where it would be time-consuming and impractical to weigh the total amount produced.

Records. Recordkeeping is often promoted as a tool for enhancing agricultural productivity – good records help farmers make informed decisions and plan ahead. For literate small-holder farmers, recordkeeping can be an important though time-intensive endeavor, but is not a viable option for small-holder farmers who are illiterate. Depending on the frequency of recording, keeping crop records can accurately capture production for crops with extended harvests (e.g., banana, cassava) or crops with staggered ripening (e.g., indeterminate[59] crops such as some beans and tomatoes). Records, such as crop cards, may be kept at the farm household or farmers' group/association level. Where possible, records can be verified by extension agents, project staff, farmer leaders, etc. during farm visits to reduce under- or over-reporting by farmers. However, there is no way to make absolutely sure farmers are self-reporting accurately in the absence of good training in recordkeeping, and motivation of the farmer.

Farmers often use different units of measure (i.e., types of containers) when measuring production. However, standardization of measuring units can be accomplished by providing households with a

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56 Ibid.

57 Murphy et al. 1991.

58 Fermont and Benson. 2011.

59 Indeterminate plants (e.g., some tomatoes) continue growing (and producing fruit) until killed by some non-genetically determined factor (e.g., frost, lack of water, insects). In contrast, determinate plants (e.g., maize) grow until reaching a genetically pre-determined size (or stage of growth), reproduce, and then die.

standard-sized bucket or other container, where feasible, and training and/or instructions for what constitutes "full." Though recordkeeping in general should be promoted as a tool for improving productivity at the small-holder level, several studies have found that farmers reported lower production estimates for certain crops (i.e., banana, cassava, maize, beans) with crop cards (e.g., forms used by farmers to record crop harvests) than through farmer recall.[60, 61] Thus, use of crop cards also requires farmers be sufficiently trained in appropriate measurement and recording techniques.

Farmer Estimates. Asking farmers to estimate their total production is perhaps one of the most convenient and least expensive ways to gather data on agricultural production. It is often employed through surveys, relying on the ability of farmers to remember (i.e., recall) how much they might have harvested of a crop or from a plot. The accuracy of production estimates from farmer recall varies tremendously; evidence of farmer error has been based primarily on differences between farmer estimates of production and those calculated with individual measurement approaches. However, Fermont and Benson report on a series of studies in which farmer estimates were closer to objective measures of production (e.g., from whole plot harvests) than were crop cuts.[62] Accuracy of farmer estimates of production may be increased by:

- Comparing with direct measurement (e.g., crop cuts,[63] whole plot harvests) for a sample of beneficiary farmers and calculating a correction factor based on the correlation between the two; and
- Gathering the data coincident with or soon after harvest.[64]

Thus, farmer recall may provide a rapid and relatively inexpensive way to collect valid data on crop production (especially when used in conjunction with a correction factor based on direct measurements). Additionally, if there is not bias in farmers' recall, the mean from a large enough sample is an unbiased estimate of the true mean. In the absence of bias or if bias is constant over time, recall estimates can provide accurate estimates of change over time.

Farmers may express production in local units, such as bags, sacks, ox carts, etc., which must then be converted to standard units, typically kilograms or metric tons. Errors easily accumulate through multiple conversions and rounding. When using farmer estimates, be clear about the units used by the farmer and if/how they can be accurately converted to kilograms or metric tons (e.g., using sampling to calculate conversions as described above in *Counting harvest units*).

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[60] Carletto et al. 2010.

[61] Sempungu. 2010.

[62] Fermont and Benson. 2011.

[63] Particularly in combination with direct measurement of area.

[64] Fermont and Benson. 2011.

Expert Estimates. Expert assessments involve either a straightforward field assessment of crop color, density, vigor, etc. or a visual assessment of the crop combined with field measurements and use of empirical formulas.[65] Such assessments involve calculating yield (not production) using its components – the number of grains per head or seeds per pod (depending on the crop) multiplied by the number of heads or pods per 5 meters of row, which is then divided by a known constant (K) that is dependent on row spacing within the field and average grain weight of the crop. Such calculations are crop specific and require close adherence to plant density and row spacing recommendations. For example, in using this method to estimate yield for grains, K is the number of grains in the half meter of row at 175 millimeter row spacing that is equivalent to 1 ton per hectare. This type of precision in row spacing is not possible in small-holder fields, limiting use of this method to anywhere but in the most mechanized cropping systems, such as those in the United States and Australia. This type of assessment can be applied on a fairly large scale. To convert to total production, yield/hectare is multiplied by the total number of hectares cultivated. However, "expert" estimates are subject to the same general types of constraints and limitations as previously noted for expert estimates of cultivated area, namely there are often not sufficient numbers of experts with the experience and expertise to make this a viable approach for most Feed the Future partners.

Remote Sensing. Estimating crop yields (production/unit area) with remote sensing involves incorporation of satellite imagery into agro-meteorological or plant-physiological models. The unique spectral signature of plants that is captured in satellite images is used to construct vegetation indices, including the Normalized Difference Vegetation Index (NDVI).[66] Ground-truthing provides verification of the correlations between NDVI values on the one hand and crop types and yield on the other.

However, the use of remote sensing for estimating crop yields (and subsequently production) is similarly problematic to that described under measuring agricultural area. It may be a viable option at the county, regional, or country levels where estimates of large unobstructed areas are reasonably reliable and accurate. Widespread application is again limited by small field or plot sizes, varied crop planting dates, interspersion of perennial trees within fields, cloud coverage, intercropping, and the need for specialized equipment and skills. An additional limitation results from the current level of resolution (i.e., pixel size) in satellite imagery; it is not detailed enough to capture nuanced differences for crops in small or intercropped fields.

Any yield measurement captured through remote sensing would then need to be converted to total production by multiplying by total area, which might also be measured with remote sensing.

Table 2 provides a quick-look comparison of the methodologies for measuring production described above.

[65] Ibid.

[66] Ibid.

Table 2. Comparison of techniques for measuring production

	Accuracy	Cost	Equipment required	Expertise needed	Level of effort	Plot size
Whole plot	high	medium	Low	low	high	small-medium
Crop cuts	medium	High	Low	medium; harvest protocols	high	large
Harvest units	medium	Low	low; measuring scales	low	medium-high	large
Records	high; varies w/quality of record keeping	Low	low; record forms	medium; literacy	high	small-large
Farmer estimates	varies; depends on timing	Low	Low	low	low	small-large
Expert estimates	medium	Low	Low	high	low	large
Remote sensing	low	High	High	high	medium	large

2. Measuring Production for Intercropping Systems

Though the same methodologies for measuring production are employed for intercrops as for sole crops, intercropping introduces certain complexities. The best methodology depends both on the spatial arrangement and the time to maturity of the component crops. For example, for intercrops in which the individual crop types are planted in fairly large blocks within the same field, most of the methods described above could be used if the crop blocks are sufficiently large to approximate single plots.

Additional complications arise for intercrops in which the crops are more intimately spaced, and particularly if one crop is fully mature and harvestable while the component crop is in early stages of its reproductive cycle (e.g., flowering, pod-fill, milk stage). Care must be taken when harvesting the mature crop to not damage the later-maturing crop.

Whole plot harvests and crop cuts work best for intercrops in which the component crops are more distant from each other (e.g., large blocks) and mature at the same time. However, both methodologies can be used for other intercrop patterns as long as appropriate accommodations are made for issues related to spacing and maturity of the crops. For intercrops in which the component crops are more intimately arranged (in space or time), harvesting and weighing the production in its entirety, counting harvested units, or using farmers' estimates may be more appropriate.

Yields (production/unit land) from intercrops are often reduced relative to yield (production/unit land) of the individual crops when grown in sole crop, which is likely to negatively impact gross margin of one or both of the commodity crops when intercropped. Intercrop arrangements in which there is spatial and or temporal complementarity – rather than competition – between the component crops may result in an "intercrop yield advantage."[67] In this case, intercropping may not negatively impact gross margin.

Feed the Future-promoted crops grown intercropped should be noted in FTFMS (Figure 5), either as part of the Deviation Narrative to explain actual results that deviate from the target, if applicable (e.g., production was assumed to be from sole crop and therefore expected to be higher than that actually produced when intercropped instead), or in the Comment section.

Figure 5. Screenshot of FTFMS

Indicator/disaggregation	2014 Deviation narrative	2014 comment	Baseline Year	Baseline Value	2014 Target	Actual
4.5(16): Gross margin per unit of land, animal, or cage of selected product (crops/animals selected vary by country)	Add	Add				

3. Measuring Production for Livestock and Fisheries

Measuring total production for livestock and fisheries products varies slightly, depending on the product. Many livestock and fisheries products are measured as weight (kilograms or metric tons). Live animals (i.e., "on-the-hoof" weights) are often weighed in crates (i.e., a collapsible chute with built-in scale). In the absence of such livestock scales, physical linear measurements of various dimensions of a live animal can be used to estimate weight. For example, common dimensions include body length (measured from point-of-shoulder to point-of-rump for beef cattle or from the base of the ear to the base of the tail for goats and sheep) and heart girth (chest circumference) for cattle, goats and sheep.[68, 69] Estimations of live-weight are based on correlations of various body measurements (e.g., heart girth) with actual weight and are specific to the breed of livestock. Although livestock-specific conversion factors between physical measurement(s) and live-weight may need to be developed by individual IPs depending on the type of activity being promoted (e.g., interventions that affect the body dimensions used to calculate conversions), standard conversion rates for some types of livestock may be available through various government agencies or ministries (e.g., agriculture, livestock, fisheries). For example, statistically significant and practical models have

[67] Each crop component produces the same under intercropping as it does under sole crop, but from less land than is required for the two sole crops. See for example Mead and Willey, 1980.

[68] Abegaz and Awgichew. 2009.

[69] Patel. 2007.

been established for certain common or widespread breeds, such as east African shorthorn zebu cattle, a multipurpose (dairy, cattle) breed found throughout eastern and southern Africa.[70]

Meat is typically measured in kilograms after slaughter and butchering, and should be totaled across each slaughter event during the reporting year for both gross margin (4.5-17) and incremental sales (4.5.2-23). Estimates of meat production can be calculated by developing project-specific conversion rates for converting live animal weight to carcass weight (i.e., excludes bones, skin/hide), particularly if interventions are expected to result in increased carcass weight per animal (e.g., improved breeds). Carcass weight reflects the "dressed" animal, or the difference between the live animal weight and what's produced from butchering (i.e., meat and organs). For example, in the context of African production systems, a carcass weight (i.e., sellable meat and organs) of 50-60 percent of live animal weight is expected, with the ideal at 60-70 percent. Thus, an animal with a live weight of 200 kg and a carcass weight of 125 kilogram produces 62.5 percent sellable product. Low conversion rates between live and carcass weight result from a variety of factors (e.g., body condition, age) and losses can result not only from the condition of the animal but also from poor filleting techniques, etc.

4. Specific Challenges to Measuring Agricultural Production

Below are presented suggestions for and solutions to specific measurement challenges related to agricultural production, which is required for gross margin (4.5-16).

Problem	Response
How should production be measured when crops are intercropped?	For gross margin (4.5-16), production from each commodity promoted by the activity should be estimated or measured.
In cases of multiple seasons (i.e., crop cycles) in one reporting year, how is production data reported?	For each Feed the Future promoted commodity, production (as well as sales, input costs, area, and any other relevant data points) should be counted for each production cycle (i.e., summed across cycles).
How is production measured for different grades of a crop? For livestock?	Production is not differentiated by grade in the FTFMS.
How is total crop production measured when the crop is shelled vs. not shelled (e.g., groundnuts), on the cob vs. shelled (e.g., maize), paddy vs. white rice?	Ideally, total production should measure the harvested crop (i.e., unshelled) rather than the processed crop (i.e., shelled). Alternatively, standardized conversion rates between shelled and nonshelled weights may be used to convert the form sold (e.g., shelled) to its equivalent in the harvested/produced form (e.g., unshelled). Country-specific extraction rates for a range of value-added commodities may be found at http://www.fao.org/fileadmin/templates/ess/documents/methodology/tcfdoc.pdf.

[70] Lesosky et al. 2013.

Problem	Response
Can we forecast what a farmer might have harvested in the event of reduced or complete crop loss from drought, flood, pests, etc.?	No. It is not valid to try to project what a farmer might have harvested. Record only actual harvest, even if significant losses from pests, disease, etc. have occurred. Document these in the notes as they provide context for the low yield. Postharvest losses are *not* subtracted from the harvest figure.
How production accounted for that is lower than planned because of losses that have occurred during the growing season?	Reporting should reflect actual results. Document reasons for discrepancies in the deviation narrative. The total amount produced may be reduced by any number of things, including suboptimum management practices, pests, diseases, floods, poor rains, low germination rates, etc.
How are sharecropping arrangements reported (i.e., the farmer only keeps a portion of the harvest)?	Postharvest use or distribution of production (e.g., home consumption, sales, land-use or debt payment) does not matter. Record the total amount produced/harvested.
Does total production include product sold plus on farm consumption and post-harvest losses?	Total production includes all postharvest loss and use (e.g., home consumption, sales, land-use or debt payment). Record the total amount produced/harvested, regardless of how it was ultimately used.
When should production data be collected?	Ideally, production data should be collected as soon after harvest as possible, though this may not always be feasible.
How is production reported for crops that have an extended production cycle (e.g., banana, cassava) or their production cycle straddles two reporting years?	For crops with an extended production cycle, total production is best calculated toward the end of the fiscal year (e.g., in September). Collect production data (and sales, input and other relevant data) over the previous 12 months, and then collect at the same time for the same reference period each year going forward. For crops with a production cycle that straddles two reporting years, total production (and all other data points relevant to that reporting cycle, e.g., input costs, sales, number of farmers applying improved technology/practices, and number of hectares) is reported during the second reporting year when all data points are available. Since the four key agricultural indicators (gross margins, number of farmers applying improved technologies, number of hectares under improved technologies, and incremental sales) are all related, you should report all four indicators in the second reporting year in these cases. This should be clearly documented in the activity's M&E Plan and in FTFMS.

Problem	Response
	Your first data points for production (and other data points) may be lower than subsequent recordings as they may represent partial harvests in the first reporting year.
Does Feed the Future prefer one method of measuring crop production over another (e.g., farmer estimates vs. crop cuts)?	Ideally, good farmer records would be the best method for collecting data on production and other data points, followed by farmer estimates as a practical, affordable and fairly reliable method. If neither of these approaches is feasible, IPs can balance the pros and cons of other methods to determine which approach provides the highest quality data possible with resources available to them.
How is production estimated if a farmer sells his/her crop in its entirety for a lump sum and no measurement of the output is made at the farm level?	Estimates of production for specific crops can be determined using median yield from randomly selected farmers within the relevant agricultural zone or across agricultural zones, depending on the amount of variation in agricultural zones within your project area.

Measuring Improved Technologies/Management Practices

Two of the indicators covered in this Guide (number of hectares under (4.5.2-2) and number of farmers and others who have applied (4.5.2-5) improved technologies or management practices as a result of USG assistance) seek to track progress in the introduction of improved technologies and management practices. One indicator involves monitoring the number of individuals that are currently using any improved technologies or management practices anywhere in the value chain, while the other involves monitoring the number of hectares on which different types of improved technologies or management practices are applied. A number of measurement issues and challenges are common to both.

> For consistency and to eliminate confusion, 4.5.2-5 has been revised: Number of farmers and others who have applied ***improved*** technologies or management practices as a result of USG assistance.

Change to 4.5.2-5. Considerable confusion surrounding the use of "new" in the title of the number of farmers and others indicator (4.5.2-5), has prompted a slight change in wording of this indicator (see box). This indicator seeks to measure the number of farmers and others (e.g., farmers, ranchers, producers, entrepreneurs, managers, traders, processors [individuals only], natural resource managers) that are applying ***improved*** [71] technologies or management practices promoted through

[71] The Feed the Future indicators assume that any "new" technology introduced is an "improved" technology.

USG-supported programs, disaggregated by value chain actor type (producers or others), technology type (crop genetics, cultural practices, livestock management, wild fishing technique/gear, aquaculture management, pest management, disease management, soil-related fertility and conservation, irrigation, water management-non-irrigation based, climate mitigation or adaptation, marketing and distribution, post-harvest – handling and storage, value-added processing, other) , and by sex. This change makes it consistent with the number of hectares under improved technology or management practices (4.5.2-2), in that both indicators are monitoring uptake of improved technologies and practices. As the number of farmers reported under the indicator on the number of farmers and others applying improved technologies or practices (4.5.2-5) increases (as captured under the "producers" Value Chain Actor Type disaggregate category), the number of hectares on which improved technologies and practices are applied is likely to increase, leading to an overall increase in productivity, sales, and ultimately, household income.

1. Measuring Improved Technology and Management Practices

In the Feed the Future context, management practice refers both to management practices applied to agricultural production systems (e.g., soil management, herd management, fish stock management), as well as management practices applied at a farm level that involve business practices, financial management, recordkeeping, etc. "Practice" and "management practice" are used interchangeably within the Guide. However, certain management practices are not land-based in that they are not applied to a farmers' field(s) (e.g., recordkeeping, financial management), and therefore cannot and should not be reported under the number of hectares under improved technology or management practice indicator (4.5.2-2).[72]

Application vs. Adoption. Currently, the Feed the Future Indicator Handbook defines the number of farmers and others indicator (4.5.2-5) as measuring the "application" of improved technologies and practices by farmers and others. Although subtle, this is distinct and different from "adoption" of improved technologies and practices. ***Application*** is the use of technology or management practice by a farmer or other producer over at least one crop season or equivalent production period in the case of livestock or fisheries. ***Adoption*** is the use of technology or management practice by a farmer or other beneficiary in a sustainable way over an extended period of time.

Sustained application of a technology or practice over an extended period of time would be required before it could be established whether the technology or practice has been adopted. The fact that farmers or other beneficiaries have applied a technology or management practice for a year or two does not mean that they have sustainably adopted it – or will continue to do so after a project ends. "Adoption" may best be determined through an assessment conducted several years after completion of activities.

[72] These management practices can be reported under the number of farmers and others applying improved technologies or practices indicator (4.5.2-5.)

Technology/Management Practice Packages. Improved technology and management practices are often promoted as packages comprising several independent technologies or practices. For example, "conservation agriculture" is often promoted as an improved technology/management practice package, and may include any combination of several independent elements (e.g., zero-tillage, use of cover crops, integrating livestock, direct seeding), each of which can lead to improved production outcomes but are more effective when applied together. Integrated pest management (IPM) represents another type of technology/management practice package. Where feasible, IPs should track each independent element comprising a technology or management practice package separately. Tracking individual elements of technology packages also allows identification of barriers to application of some technologies relative to others. Where appropriate, a custom indicator could be developed to track application of the entire package.

Research

Neither the value of incremental sales (4.5.2-23) nor gross margin (4.5-16) indicators are likely to be relevant for the majority, if not all, Feed the Future research projects.

However, if a research project involves activities specifically designed to disseminate (e.g., through local NGO or other partners), improved technology or management practices to small-holder farmers, then both of the technology indicators are appropriate (4.5.2-2 and 4.5.2-5).

Research activities with a primary objective of developing improved technologies or practices but that do ***not*** involve dissemination activities directly linked to beneficiary farmers and others should not be reporting these indicators. These activities should report against the number of technologies or management practices in different phases of development indicator (4.5.2-39.)

Disaggregation Categories

Sex Disaggregate. "Association-applied" is applicable to the number of hectares indicator (4.5.2-2) but not appropriate for the number of farmers and others indicator (4.5.2-5). It can be used:

- For formal or informal groups (e.g., association, organization, women's group, savings group, cooperative, farmers group) that apply improved technologies or management practices on a common or group area of land (e.g., demonstration or training plot, association-farm plot used for sales of commonly produced commodities), and
- If the technology or management practice is land-based (and therefore can be measured in hectares).

For example, if a group of farmers is applying an improved technology or practice on a demonstration plot, then the hectares are classified under 4.5.2-2 as "association-applied." The farmers group is counted as one group under the Feed the Future indicator for groups applying improved technology or practices (4.5.2-42). It is <u>not</u> counted under the number of farmers applying improved technology (4.5.2-5), which only counts ***individuals*** applying improved technologies or management practices on individual plots or elsewhere in the value chain.

If the individual members of the group also apply the technology or practice on their own land, apart from the group plot, then they ***are*** counted under the indicator for farmers and others applying improved technologies or practices (4.5.2-5) and disaggregated by male or female.

If the demonstration or training plot is cultivated by extension agents or researchers (e.g., a demonstration plot in a research institute), neither the area nor the extension agent/researcher should be counted under the number of hectares (4.5.2-2) or the number of farmers and others (4.5.2-5) indicators.

If the IM involves associations as direct beneficiaries, Feed the Future's indicator referring to "groups"[73] (4.5.2-42) is the appropriate indicator for tracking the spread of improved technologies or management practices, rather than with the number of farmers and others indicator (4.5.2-5).

Technology and Management Practice Type Disaggregate.

Type of improved technology or management practice is disaggregated under the number of hectares (4.5.2-2) and under the number of farmers and others (4.5.2-5) indicators. The 2014 Feed the Future Indicator Handbook added the Technology Type disaggregate to the number of farmers and others (4.5.2-5) indicator and added one Technology Type disaggregate category ("Cultural practices") to the number of hectares (4.5.2-2) indicator. The Technology Types categories under number of farmers (4.5.2-5) includes all of the categories under the number of hectares indicators, and additional categories that reflect technologies and practices that are non-land-based (i.e., not applied in farmer's fields.) See Table 3 for a comparison of the technology type disaggregate categories for the two indicators, and the revised PIRS for 4.5.2-2 and 4.5.2-5 in Appendix 1 for further detail.

Table 3 Technology type disaggregate categories for number of hectares and number of farmers and others indicators

Number of hectares (4.5.2-2)	Number of farmers and others (4.5.2-5)
Crop genetics	Crop genetics
Cultural practices	Cultural practices
Pest management	Pest management
Disease management	Disease management
Soil-related fertility and conservation	Soil-related fertility and conservation
Irrigation	Irrigation
Water management	Water management
Climate mitigation or adaptation	Climate mitigation or adaptation

[73] 4.5.2-42 Number of private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBO) that applied new technologies or management practices as a result of USG assistance.

	Livestock management Wild fishing technique/gear Aquaculture management Post-harvest handling & storage Value-added processing Marketing and distribution
Other Total w/one or more improved technology/practice	Other Total w/one or more improved technology/practice.

Although examples of specific technologies or management practices are provided for each Technology Type disaggregate category in the PIRS, there is no fixed set of technologies defined for each disaggregate. Nor is it feasible to provide a list capturing everything being promoted by IPs. Thus, ***each IP should determine under which Technology Type disaggregate category the technology or practice being promoted by the IM is best classified.***

In those instances where the technology or practice being promoted through the IM does not fit under the defined technology or practice disaggregate categories, an "Other" category is provided. When using this category, the specific technologies or practices categorized under "Other" should be described in the Activity M&E Plan and FTFMS indicator notes.

The Technology Type disaggregate category "Total with one or more improved technology/practice" measures the total number of hectares under and the total number of farmers and other applying any of the IM's promoted improved technologies and practices.

"Double counting," or separate reporting, of farmers and others (and hectares) only occurs in the Technology Type disaggregation categories, not in the Sex disaggregate categories. For example, in Table 4, a female direct beneficiary farmer applies improved seed and a pest management practice in Years 1 and 2, and adds a drip irrigation system in Year 3. She is counted once under each relevant technology type each year - - under two categories in Years 1 and 2 and under three categories in Year 3. However, in all years, she is only counted once under the "number with one or more technology" Technology Type category and the relevant Sex disaggregate category.

Table 4. Same farmer with more than one technology or practice

	Year 1	Year 2	Year 3
Male			
Female	1	1	1
Crop genetics	1	1	1
Irrigation			1
Pest Management	1	1	1
One or more tech	1	1	1

2. Specific Challenges Measuring Improved Technology and Management Practices

Challenges associated with measuring improved technology and management practices apply to both 4.5.2-2 and 4.5.2-5. Suggestions for and solutions to specific challenges related to measuring improved technology or management practices for both indicators are presented below.

Problem	Response
Can improved technologies/ practices be tracked by value chain?	Neither indicator (4.5.2-2 and 4.5.2-5) is disaggregated by commodity. If an IP wants to track application of improved technologies/practices by value chain, it should create a custom indicator or custom disaggregates and track this internally.
Is it expected that the number of farmers or hectares for applying improved technologies and practices be monitored during research trials, or only when the improved technologies or practices are rolled-out?	If the technology or practice is in field trials, then it is not counted as having been applied by a farmer or applied to hectares and is not reported for either 4.5.2-5 or 4.5.2-2. There is a Feed the Future indicator specifically for monitoring technologies at different phases of research and development, up to the point that they are made available for dissemination, that is more appropriate in this case. *(See 4.5.2-39 in the Feed the Future Indicator Handbook.)*
How can livestock technologies and practices (e.g., vaccines, Artificial Insemination (AI), and de-worming) that are not land-based (i.e., applied in farmers' fields) be measured?	Livestock/fisheries technologies or practices that are not land-based should be reported under number of farmers and others (e.g., fishermen) applying improved technologies or management practices (4.5.2-5).
Are marketing practices and recordkeeping considered improved technologies or practices?	Assuming they are being promoted as improved technologies or practices through your program, marketing practices should be counted under the Technology Type dissagregate Marketing and Distribution category and recordkeeping counted under Other (assuming the recordkeeping isn't marketing related) for the number of farmers and others (4.5.2-5) indicator. However, neither can be measured by hectare, and should not be reported under number of hectares (4.5.2-2).
For integrated technologies or technology packages (e.g., those that involve several independent elements), how many elements constitutes "application"?	For technology and management practice packages involving separate elements that can be applied independently rather than as a whole and still result in improved productivity, each element should be tracked separately. An IP may create a custom indicator to track application of a minimum set of practices or the entire technology package.
How strictly must a farmer follow recommendations for use of a specific technology (e.g., application rate, dosage, timing of application) to be considered as "applying"?	Ideally, all recommendations associated with an improved technology or practice should be followed in order to be counted as applying that technology or practice. When appropriate, report why all recommendations on use/application of a particular technology or practice were not adhered to and document what was done by the activity to

Problem	Response
	address it.
If an improved crop variety is demonstrated in one type of cropping system (e.g., mono-culture) and is then used in a different cropping system (e.g., intercrop), does that count as "applied"?	Ideally, all recommendations associated with an improved technology or management practice should be followed in order to be counted as applying that technology or practice. Thus, it is important to understand what is being promoted and how. If an improved variety is promoted specifically for monocropping and is used in an intercrop, then it would not be considered as "applied" under either 4.5.2-2 or 4.5.2-5. If an improved variety is promoted as part of a specific intercrop system (i.e., the improved variety is specifically recommended for the intercrop system being demonstrated) and is used in a different intercrop system, it would not be considered as applied under either 4.5.2-2 or 4.5.2-5. If an improved variety is promoted as part of "intercropping" generally but not to a specific intercrop system per se, and is used in a different crop system than what was demonstrated, then it could be considered "applied" under both 4.5.2-2 and 4.5.2-5.
What happens when a farmer plants more than once on the same piece of land in a reporting year (i.e., multiple crop cycles)?	For number of hectares (4.5.2-2), the hectare is counted each time an improved technology or practice is applied to it, which means a hectare may be counted more than once during the reporting year (i.e., "double counted") under the relevant technology or management practice disaggregate category. For example, if a farmer cultivates maize twice (two production cycles) in a reporting year, and applies the same or different improved technology or management practice in each production cycle, the plot of land is reported under the appropriate technology or management practice for each time it was applied during the reporting year. *(See Understanding the Indicators, 4.5.2-2).* For number of farmers and others (4.5.2-5), a beneficiary is counted once under the appropriate Sex disaggregate category regardless of the number of technologies applied during the reporting year. Under the Technology Type disaggregate, if the beneficiary applied more than one type of improved technology, the beneficiary is counted once under each relevant technology or management practice disaggregate category (i.e. double-count), then counted once under the total w/one or more improved technology category.
How are the number of farmers and others applying (4.5.2-5) and the number of hectares under (4.5.2-2) improved technology/practices reported when crops are intercropped?	For number of farmers and others (4.5.2-5), a farmer is counted once – and only once – if at any time during the reporting year they applied at least one technology or practice promoted by the project to at least one of the targeted intercropped crops. For number of hectares (4.5.2-2), if a technology or practice is applied to all target intercropped crops or to a primary target

Problem	Response
	crop in an additive intercrop arrangement, the total area is reported. If a technology or practice is applied to only one of the target intercrops in a substitutive arrangement or to the target secondary crop in an additive arrangement, proportionally estimate or measure the area on which the technology or practice is applied. If intercropping is the improved practice being promoted, measure the total area under cultivation.
How should the number of farmers or hectares be counted when more than one IM is promoting the same improved technologies/ practices in the project area?	Those farmers and hectares should be counted when they are direct beneficiaries of the IM. It does not matter if other activities are also working (or have worked in the past) in that area or with the same farmers.
Where does plant density as a management practice fit?	Appropriate plant density should be categorized under "Cultural Practices."
How is leaving a field fallow reported?	Fallowing could be considered an improved management practice and reported under both the number of farmers (4.5.2-5) and number of hectares (4.5.2-2) indicators.
How are results disaggregated by sex for farmers applying improved technologies/practices in groups?	The "association-applied" Sex disaggregate category should be used when reporting under number of hectares (4.5.2-2). The group is counted as one group under the indicator on groups applying improved technology or management practices (4.5.2-42). An individual member of the group is only counted under the farmers and others applying indicator (4.5.2-5) if s/he applied the technology or practice on her/his individual plot.

Measuring Agricultural Sales

Data on the amount of agricultural production that is sold are required for both the gross margin (4.5-16) and value of incremental sales (4.5.2-23) indicators. Agricultural sales are reported as the total value of the sales in USD under both indicators (4.5-16 and 4.5.2-23). For gross margin (4.5-16), data for the volume of sales must be in the same units as data reported for production. For value of incremental sales, volume of sales are reported in metric tons. Thus, volume of sales reported under gross margin may need to be converted to metric tons in order to align with volume of sales as reported under value of incremental sales (4.5.2-23).

1. Measuring Sales From Agriculture

Unlike other data points discussed in this Guide, there is not a wide diversity of standardized methodologies available for collecting valid data on the value of sales from Feed the Future farmers and other producers. Because Feed the Future activities focus heavily on farmer and producer "progress toward commercialization," many IMs involve value chain activities that are implemented through farmers' or producers' groups, associations or cooperatives. Thus, records (e.g., farmer, organizational) often constitute a primary means for collecting farmers' sales information. Farmer recall is also a common method for collecting sales data and can be quite accurate when collected close to or in conjunction with sales events, though this may require multiple data collection efforts by IPs within a single reporting year.

Prices vs. Sales. IPs are not required to report prices per unit sold, only the full value of sales. However, the value of the sale depends on the amount sold and the price at which it was sold. Prices vary by crop, location (e.g., farm-gate, local market), season, market conditions, prevailing national and international demand and supply conditions, quality of the product, etc. The gross margin and value of incremental sales indicators (4.5-16 and 4.5.2-23, respectively) measure the value of sales received by the farmer (i.e., "farm-level"), regardless of where the product was sold (e.g., farm-gate, local markets, distant markets, processors, institutions, etc.) and what price was received for each sale.

Measuring Value. This represents the sum of money the farmer receives for the output that s/he sells at the farm-gate, on the market, to middlemen, processors, etc. All commodity-specific sales conducted throughout the reporting year are summed and the total value in USD entered into FTFMS. Sales (in local currency) should be converted to USD using the average market exchange rate during the reporting period or converted periodically throughout the year if there is rapid devaluation or appreciation. Exchange rates for most currencies, both for specific dates and averaged over any period of choice, are available online from websites such as www.oanda.com.

Data on value of sales is typically collected through farmer recall or records. As previously noted, the accuracy of farmer recall varies widely. Approaches to improve accuracy often prioritize the collection of information just after harvest, when farmers are typically selling all or much of their production, or periodically throughout the year (e.g., quarterly).

Measuring Volume. For incremental sales (4.5.2-23), the amount of commodity sold is reported as a weight (i.e., metric tons) and is typically measured by weighing either the entire amount sold (whether sold all at once or over a period of time) or converting the number of units sold (e.g., bags, buckets, pails) to total weight using an average weight per unit (see *Measuring Agricultural Production*).

For gross margin, livestock products in particular can be reported as either a weight or number (e.g., number of live animals sold). If reported as a number (e.g., number of crates of eggs), data must be converted to metric tons for reporting under incremental sales (4.5.2-23). If direct measurements of the entire amount sold are not feasible, an average weight per unit (e.g., animal, crate) can be used to estimate total sales volume. Issues related to the accuracy of measuring volume sold are similar to those related to accuracy of measuring total volume produced, and are discussed in *Measuring Agricultural Production*.

A commodity might differ in how it is harvested/produced and how it is sold. For example, harvested peanuts are weighed in their shells to provide a measure of total production. However, if they are sold as shelled nuts, the volume of sales needs to be converted to its nonshelled equivalent before entry into FTFMS. As noted in the revised Feed the Future Indicator Handbook (Appendix 1), country-specific extraction rates for a range of value-added commodities may be found at http://www.fao.org/fileadmin/templates/ess/ documents/methodology/totdoc.pdf. The revised PIRS uses the example from Malawi, where the extraction rate between unshelled and shelled peanuts is 65 percent. If 1,500 kilograms of shelled peanuts are sold, the equivalent weight of unshelled peanuts is 2,304 kilograms (1,500/.65). Thus, 2,304 should be entered as the volume of sales rather than 1,500 (assuming total production was measured in kilograms of unshelled peanuts). Volume of sales and production should be measured and reported in the same way for each reporting cycle.

Sales of value-added products (e.g., flour) are included in value and volume of sales data collected by commodity for both the gross margin and incremental sales indicators, assuming the farmer or primary producer conducts the postharvest processing of his/her production prior to sale. The value-added product is simply another form of the same primary product (i.e., grain on the one hand and flour on the other). ***Sales should include sales of both the primary and value-added product.*** However, the value-added product must be converted to its harvested form (e.g., maize flour converted to its equivalent in maize grain) and then added to the amount of the primary product sold. Sales of byproducts (e.g., maize stalks, peanut shells), however, are ***only*** reported under incremental sales and are not reported under gross margin (see section on *Measuring agricultural production*).

2. Specific Challenges Measuring Sales From Agriculture

Challenges associated with measuring agricultural sales in both value and volume are similar for gross margin (4.5-16) and value of incremental sales (4.5.2-23). Suggestions for and solutions to challenges measuring agricultural sales (volume and value) are presented below.

Problem	Response
How are in-kind transactions valued?	In-kind transactions are not included. Values are reported only on cash sales by the farmer or producer.
How are sales valued that are made throughout the year and at various prices?	Only the total value of sales is reported. Sales made at multiple times should be summed for the reporting year. Sales made throughout the reporting year are converted to USD using the exchange rate at the time of the sale or averaged for the reporting year. The total USD value is entered into FTFMS.
How is the amount sold from multiple harvests reported?	If a farmer or other producer harvests and sells a targeted commodity more than once in the reporting year, sales value and volume should be summed across production cycles. For example, if a farmer produces two maize crops during the reporting year, volume of sales (as well as area, production, value of sales and input costs) is summed across both crop production cycles and entered into FTFMS for the reporting year.
What happens when harvest and sales straddle two reporting years (i.e., when the production cycle begins in one reporting year and ends in the subsequent reporting year)?	For crops with a production cycle that straddles two reporting years, the four related key agricultural indicators (gross margins, incremental sales, number of farmers applying improved technology/practices, and number of hectares) should be reported during the second reporting year when all data points are available. This should be clearly documented in the activity's M&E Plan and in indicator notes in FTFMS.
How are sales of byproducts (e.g., maize stalks, peanut shells, cowpea hulls) valued?	Byproduct sales (e.g., maize stalks gleaned from the field and sold as animal fodder) should not be reported under gross margin (4.5-16) unless the byproduct has been identified as a distinct value chain commodity. If a maize value chain includes two distinct commodities, one of which involves byproducts of the primary product, then sales of both products would be reported under gross margin, but as different commodities. For example, if a maize value-chain activity involved producing maize to be sold as grain, as well as a farmer-processed and sold animal fodder from maize plant residues, sales (value and volume) of each commodity are reported separately under gross margin (4.5-16). However, as two different commodities derive from the same cultivated field, the number of hectares cultivated, as well as input costs, should be allocated proportionally *based on the total income from both products* and reported under gross margin for each commodity. Although not ideal, it is acceptable to Feed the Future. Production and sales value/volume are unique to each commodity. For incremental sales (4.5.2-23), all farm-level sales of the primary product (including value-added) and byproducts can be summed and reported. The volume of primary and byproducts sold should be converted to metric tons and summed.

Problem	Response
How are sales of value-added products (e.g., flour) counted?	If the farmer or primary producer does the postharvest processing of part or all of his/her production prior to sale, then value of sales for the commodity should include sales of both primary and value-added products, when applicable, and reported under both gross margin (4.5-16) and incremental sales (4.5.2-23). The amount (volume) of value-added product sold should be converted to the harvested form and then added to the amount of any primary product sold before entry into FTFMS.
How is the volume of sales measured when the commodity is sold in a different form than it was produced (e.g., shelled vs. not shelled, on the cob vs. shelled)?	The amount sold as shelled (i.e., its processed form) must be converted to its equivalent in harvested/produced form (e.g., unshelled). Country-specific extraction rates for a range of value-added commodities may be found at http://www.fao.org/file admin/templates/ess/documents /methodology/totdoc.pdf.
Are prices calculated at the farm-gate or farm-level?	Information on price is not needed for the Feed the Future indicators covered by the Guide. Both gross margin and incremental sales indicators measure the value of sales received by the small-holder farmer/producer, regardless of where the product was sold (e.g., farm-gate, local markets, distant markets, processors, institutions, etc.) or at what price it was sold.
How is inflation accounted for?	Inflation is reflected in the dollar exchange rate, since sales are converted to USD at the prevailing market exchange rate.
How are fluctuations in the US exchange rate dealt with?	The indicator requires conversion to USD using the average market exchange rate for the reporting period (fiscal year). In cases where the exchange rate is very volatile or there is rapid devaluation or appreciation, market exchange rates may need to be captured at various points in the year, and sales values converted depending on when the sales were made.
Does conversion to USD include purchasing power parity (PPP)?	No. Indicator values are converted to USD equivalents rather than to comparable international purchasing power.
How are sales to government buy-back programs valued (e.g., when government-guaranteed prices are higher/lower than markets)?	The indicator measures the value of sales received by the small-holder farmer/producer, regardless of where the product was sold (e.g., farm-gate, local markets, distant markets, processors, institutions, government buy-back).
How are sales valued if a farmer doesn't know the price, e.g., when he or she sold their product through a cooperative?	Information on price is not needed for Feed the Future. Only the total value of sales is reported.
How are changing prices and market conditions resulting from shocks (e.g., drought, global food prices) beyond the control of the program dealt with?	Reporting should reflect actual results. Events beyond the control of the program should be included in the deviation narrative to help provide context and explanation of results.

Problem	Response
For programs involving production of many horticultural crops, is sales data collected as the lump-sum of total sales?	For gross margin (4.5-16), sales are reported by horticultural product. If a large number of horticultural crops are produced, IPs may choose to report sales volume and value (along with the three other gross margin data points) for the five most commonly produced horticultural products in your program. For example, tomato, onion, pepper, carrots, and cabbage. For value of incremental sales (4.5.2-23), sales can be reported disaggregated by horticultural commodity, or under the commodity disaggregate category "Horticulture."
The value of milk sales collected from farmer records often differs substantially from records received from their co-ops. How can we validate which is correct?	Ideally, you need to understand why the two types of records differ. For example, if the farmer's records show higher sales values than the co-op's records because the farmer records include side sales of milk, then the farmer records are more accurate and should be used. If, on the other hand, each record contains unique information regarding the farmer's sales (i.e., information is not duplicated across the co-op and farmer records), then data from the two records could be combined. How data are collected should be documented and the data must be collected in the same way for each reporting period so that changes observed over time are not due to changes in data collection method.
Is there any guidance on estimating crop prices based on standard moisture content (e.g., 14%) at the point of sale?	Information on price is not needed for Feed the Future. Only the total value of sales is reported.
How can adjustments be made to account for cheating by middlemen and other intermediaries involving sales based on underestimation of the volume sold (e.g., demanding an extra unit of product for every nine sold, overfilling of a standard container without adjustments to the weight)?	Reporting should reflect actual results, i.e., the sales revenue actually received by the farmer, not what he or she would have received from an honest intermediary. Feed the Future activities promoting accurate measurement of agricultural production and sales, combined with appropriate recordkeeping, may help minimize or eliminate such issues.

Measuring Agricultural Input Costs

Estimates for the recurrent cash costs of inputs used by farmers in their production activities are one of five components of gross margin (4.5-16). Total income from the sales of agricultural products minus cash outlays related to producing those products provides a measure of net income to the farm household. According to the Feed the Future Indicator Handbook, ***only those costs that make up more than 5 percent of the total costs of purchased recurrent inputs need be***

collected. It is not necessary to calculate actual percent contribution of individual inputs to total input costs in order to determine which inputs account for at least 5 percent of total cash costs. IPs may simply estimate which inputs would qualify and collect data only on those. However, all recurrent cash input costs can be reported into FTFMS if the IM collects such data as part of their M&E activities.

Estimates of capital investments, in-kind inputs, or unpaid labor (e.g., family members) are not included in the measures of input costs. This avoids the complication of valuing depreciation, in-kind inputs, and family labor in order to focus on recurring (e.g., annual) cash expenditures, which represent the most risky types of investments made by poor farmers. Excluding noncash or nonrecurring input costs from the calculation introduces certain challenges in interpretation (see Gross Margin in *Understanding the Indicators*), but far outweighs the complexity that would be introduced in order to value such costs (i.e., calculating depreciation, market prices for in-kind inputs, and shadow prices for unpaid labor or associated opportunity costs). This approach introduces some degree of bias in areas where farmers make few cash investments in production activities and most inputs are in-kind (e.g., subsistence farming for home consumption). However, Feed the Future programs generally promote moving poor, small-holder farmers and other producers toward market engagement and commercialization, and away from reliance on in-kind inputs and services.

1. Methods for Measuring Input Costs

Farmer records or recall are the primary methods used by IPs to collect data on annual costs of inputs for agricultural production activities. As previously mentioned, accurate records are often in short supply and farmer recall often suspect, although evidence exists supporting farmer recall as a potential unbiased estimate, especially the closer to the event the data are collected – including for input costs.[74, 75] Farmer-kept records are not possible if farmers are primarily illiterate. Data must either be collected through another means (e.g., farmer recall) or literacy interventions may need to be promoted as an activity. For illustrative purposes, a sample tool for recording farmer input costs is provided in Appendix 8. IPs should adapt the types of costs to the program context and extend or roll-up categories according to the depth of information desired.

[74] Beegle et al. 2011.

[75] Fermont and Benson. 2011.

2. Specific Challenges Measuring Input Costs

Challenges to measuring recurring cash input costs, one of five data points required for gross margin (4.5-16), and suggested solutions are presented below.

Problem	Response
How are costs allocated when inputs are used on more than one crop (excluding intercropping) or more than one reporting cycle?	Though not ideal, input costs can be allocated by the area of each crop to which inputs are applied. When straddling two reporting cycles, input costs should be reported in the year in which the harvest takes place.
How are costs allocated for intercrops?	If inputs are used on both crops, costs are allocated proportionally based on the area of each crop to the total area, *regardless of intercrop arrangement*. If inputs are used on only one crop, costs are reported as the total cost of the input(s), regardless of intercrop arrangement.
How are input costs reported for agricultural products that require up-front investment years before realizing any returns from sales (livestock, fruit trees and other tree crops, coffee)?	Because of the nature of the product, input costs are reported in the years in which they occur. Targets should reflect no sales for several years. For example, if fruit trees are planted in the first year of an activity and not harvested until year 4, the input costs should be reported each year and may result in zero or negative gross margin until year 4. It is important to make sure farmers have alternative sources of income to sustain themselves until they start receiving a net return from the crop(s).
How are seeds that are saved from a previous harvest and planted in the next year valued?	They would be considered an in-kind input, and would not be included as a recurrent input cost. Only recurrent inputs that are purchased with cash are included.
What if certain inputs are provided by the program (e.g., via extension agents, lead farmers, farmers' associations, etc.) and paid back by the farmer later in-kind?	Only cash recurrent input costs incurred by the farmer are included in the gross margin indicator. The value of inputs paid back in-kind should not be included.
Given that costs associated with renting land for cash are included as an input cost, how is land that is owned by the farmer/producer valued?	Land that is owned and cultivated by a beneficiary farmer is considered an in-kind input and is not included.
How are investments in irrigation and other equipment valued?	Capital investments and depreciation are not valued as part of gross margin (4.5-16). Only recurrent inputs that are purchased with cash are included.
For programs involving production of many horticultural crops and inputs are applied to several or all, how are input costs allocated across crops?	Input costs can be allocated by the area of each crop to which inputs are applied.

Problem	Response
How are inputs that are provided to the farmer by the buyer at the beginning of the season accounted for?	If the farmer pays back the input in cash, it would be included. If the farmer pays back the input in-kind (i.e., pays with some portion of the total produced) at the end of the season, then it would *not* be included. Data on input costs should be collected both after planting and after harvest, as certain input costs occur at multiple times during the crop cycle (e.g., labor).
How are farm-based inputs (e.g., compost) valued?	Only recurrent inputs that are purchased with cash are included.
How are the costs of inputs that are purchased in bulk and distributed among farmers/producers calculated?	When purchased in bulk (whether by a farmer or association), input costs per farmer can be estimated as a percentage of the total input received by the farmer (e.g., kg of fertilizer, liters of pesticide, number of doses of medicine). For example, if a farmer receives 50 pounds of a 100 pound bag of fertilizer that costs USD 150, his/her estimated cost would be USD 75.
How are the costs borne by a farmer that result from externalities created elsewhere (e.g., upstream water-use) calculated?	Only recurrent inputs that are purchased with cash are included. Many agricultural activities create external costs, but these are not included in the value of input costs for the gross margin indicator.
How is the incorrect or partial use of inputs valued (e.g., using less/more than recommended dose or application rate)?	Reporting should reflect actual use of inputs. It should not be assumed that farmers correctly follow recommendations regarding input use (e.g., timing of pesticide applications, dosage, planting density). Thus, IPs should not use recommendations on use of inputs to impute farmers' costs.
How is family labor valued?	Unpaid family labor is not valued as part of gross margin (4.5-16). Only recurrent inputs that are purchased with cash are included.

Understanding the Indicators

This section addresses issues specific to each of the four indicators. These include what is measured, FTFMS reporting, and how data are interpreted. Reporting on performance indicators also involves reporting on the factors that affect quantitative results ("numbers and narrative") and should be included in the narrative in order to tell a more comprehensive story regarding performance. Each subsection discusses indicator-specific issues, followed by suggestions/solutions for how they may be addressed.

4.5-16 Gross Margin

Recent changes to Gross Margin reflected in the Guide:[76]

- How to report when production cycle straddles reporting years.
- Report unit of measure for total production and value of sales.

In the Feed the Future context, gross margin is a measure of net income from targeted agricultural products (farm/livestock/fisheries) produced by small-holder farmers, pastoralists and other primary producers that receive USG assistance and is expressed as the difference between the total value of production of the agricultural product (crop, milk, eggs, fish) and the cost of producing that item, divided by the total number of units used in production (hectares of crops, number of animals for milk, meat, live animals, hides/skin and eggs; pond area in hectares; or cages for open water aquaculture). It is designed to help farmers decide which farm activities and products are best pursued in terms of net revenue.

For each value chain commodity, gross margin is calculated from five distinct types of data, each of which represents data for all direct beneficiaries:

1. Total production during reporting period (**TP**);
2. Value of Sales (USD) during reporting period (**VS**);
3. Quantity of Sales during reporting period (**QS**);
4. Purchased recurrent input costs during reporting period (**IC**) (data required only for those costs that are at least 5 percent of total costs, although all recurrent input costs can be reported); and
5. Unit of Production (**UP**): Hectares planted (for crops); Number of animals (for meat, milk, eggs, live animals); Area (ha) of ponds or Number of cages (for fish from aquaculture) during the reporting period.

Once the five data points (disaggregated by sex) are entered into the FTFMS, the commodity-specific gross margin is automatically calculated as:

$$\frac{[(\mathbf{VS}/\mathbf{QS}) * \mathbf{TP}] - \mathbf{IC}}{\mathbf{UP}}$$

As such, the indicator reflects gross margin per unit of production (i.e., hectare, animal, cage).

Rationale for Indicator Choice. Agricultural entrepreneurs and producers (e.g., farmers, ranchers) are provided opportunities to improve their business approach through participation in production, entrepreneurship, and management activities. Higher gross margins imply that the small-holder

[76] See Appendix 1 for the 2014 revised PIRS.

farmer or producer has improved productivity through implementation of better technologies or management practices and engagement in profitable markets. It is a measure of the degree to which small-holder farmers and producers are utilizing practices that improve their bottom line.

This indicator can be used a farm management tool for farmers to make management decisions regarding changes in practice that lead to improved productivity and, ultimately, income. Based on the Feed the Future RF, improvements in gross margin of agricultural products ultimately leads to reduced poverty and hunger. Alternatively, activities targeting the extremely poor and vulnerable ("the poorest of the poor") may emphasize increasing production (both volume and variety) for home consumption.

For programs in which agricultural activities are not market-oriented, and are designed to increase farmer production per se (e.g., food and nutrition-security programs that focus on increased production for home consumption), gross margin may not be an appropriate performance indicator. However, given the risks of failure associated with many agricultural activities, farmers may be more likely to adopt improved technologies and management practices if there is an economic incentive to do so. The economic incentive that drives many, if not most, farmers is cash. Thus, if increased market engagement, profitability and income are not relevant to your programming, the issue may be larger than whether or not gross margin is an appropriate performance indicator. Rather, the likelihood of overall success for such a program may be questionable. Without positive net revenue (in this case from agricultural activities promoted through Feed the Future interventions), economic growth will be limited and unlikely to support sustainable improvements in people's well-being.

What's Being Measured. There are several things of note in the definition and calculations that are important for interpreting gross margin (Table 5). First, this indicator is expressed as "production unit margin," in this case, total value of production – total recurrent cash costs divided by the number of hectares/animals/cages, rather than as total margin (total value of production – total recurrent cash costs).

Secondly, production data reflects total production; ***home consumption and other postharvest uses are not subtracted from production figures even when home consumption constitutes a relatively significant use of the commodity or product.*** The total amount sold (volume and value) is only used to calculate an average unit value that is then used to value the entire amount produced – including any amounts used for other purposes, such as home consumption or in-kind debt repayment. Thus, it is important that the volumes produced and sold are reported in the same units and in the same form. FTFMS contains a unit of measure data fields to identify what is the common unit of measure used.

Table 5. Units of production and sales

Gross margin data points	Different units for production and sales		Same units for production and sales	
Production	1.5	mt	1500	Kg
Sales volume	1000	kg	1000	Kg
Sales value	350	USD	350	USD
Recurrent cash input costs	70	USD	70	USD
Area	**15**	**ha**	**15**	**ha**
Value of production	0.525	USD	525	USD
Gross margin/hectare	-4.6		30.3	

Since gross margin measures the value of everything produced (regardless of whether it was sold or not), ***the indicator can be interpreted as measuring what farmers could have earned net of recurrent cash costs per unit of production if they had sold their entire production.*** This is important as many IPs report dissatisfaction with this indicator as not accurately representing net returns to the farmers. Indeed, this indicator does not measure net return unless they sold everything.[77] Even then, it is not a truly representative measure of such returns because it purposively excludes certain costs incurred by many farmers, specifically unpaid labor and other in-kind inputs, and capital investments (e.g., purchased land, irrigation infrastructure). Thus, direct comparisons of gross margin between farmers who hire labor with those relying on unpaid labor, for example, are potentially misleading (see box).

At this point, including in-kind and other costs in order to provide a "more accurate" measure of return to the farmer constitutes a change in the definition of the indicator. ***All data previously reported for gross margin would then become obsolete because they would represent different results.*** Although imperfect, exclusion of in-kind costs was

Gross Margin

High gross margin per unit of land does not always translate into the best returns to farmers. The example below illustrates a project involving cassava and groundnuts in which the gross margin for groundnut is considerably higher than that for cassava, yet return to the farmer in terms of family labor are higher for cassava than for groundnut.

Cassava

Hectares = 1
Production = 7,500 kg
Total recurrent costs = USD 250
Value of sales = USD 400
Volume of sales = 5,000 kg
Gross margin = USD 350/ha
Family labor days = 14/ha
Return to family labor = USD 25.00/day

Groundnut

Hectares = 3
Production = 11,400 kg
Total direct costs = USD 2508
Value of sales = USD 5,100
Volume of sales = 8,640 kg
Gross margin = USD 1,407/ha
Family labor days = 230/ha
Return to family labor = USD 6.12/day

[77] The data points for value of sales and cost of recurrent cash inputs could be used by IPs or Missions to estimate net cash profit.

intended to simplify measurement of the indicator by eliminating the complexity of valuing in-kind inputs yet still provide a robust measure of (potential) return per unit of production.[78]

FTFMS Reporting. For each Feed the Future commodity, ***calculation of the commodity-specific gross margin occurs automatically once all five data points (disaggregated by sex) are entered into the FTFMS*** (Figure 6). Each sex disaggregated data point has either been summed across all relevant direct beneficiaries (e.g., from data collected from all direct beneficiaries) or extrapolated to all direct beneficiaries (e.g., from data collected through a sample of direct beneficiaries).

For gross margin, data are entered layered, that is, for a specific target crop, five data points (units of production, total production, volume of sales, value of sales, input costs, plus the common unit of measure used for total production and volume of sales) for male beneficiaries are entered, five data points plus units of measure for female beneficiaries are entered, etc. Once the data are entered, FTFMS sums the sex disaggregated figures for each of the five data points and enters the sum in cells b-f.

For example, the number of hectares planted by males is entered, the number of hectares planted by females is entered, as well as hectares for joint, association-applied or disaggregates not available, where appropriate. However, no figure is manually entered into cell "b," as this figure is automatically calculated by FTFMS. This holds true for the other four data points (c-f); sex disaggregated data is entered for each data point and the total of each data point is automatically calculated.

Commodity-specific gross margins are also automatically calculated for males, females, joint, and association-applied sex disaggregate categories (bold). Finally, FTFMS calculates the commodity-specific gross margin indicator value (a).

[78] Feed the Future implementing partners can, and do, collect data on in-kind inputs (e.g., unpaid labor) for internal analysis purposes, although this data is not reported in FTFMS.

Figure 6. FTFMS data entry for gross margin

Indicator / Disaggregation	2014 Deviation Narrative	2014 Comment	Baseline Year	Baseline Value	2014 Target	2014 Actual
4.5 (16): Gross margin per unit of land, animal, or cage of selected product (crops/animals selected vary by country)	Add	Add				
Maize Total Production, Quantity of Sales measured in						a
Male						
Female						
Joint						
Association-applied						
Hectares planted (for crops); Number of animals (for milk, eggs); or Area (ha) of ponds or Number of crates (for fish)						b
Male						
Female						
Joint						
Association-applied						
Disaggregates Not Available						
Total Production (Measured using units selected above)						c
Male						
Female						
Joint						
Association-applied						
Disaggregates Not Available						

Figure 6. FTFMS data entry for gross margin (continued)

Indicator / Disaggregation	2014 Deviation Narrative	2014 Comment	Baseline Year	Baseline Value	2014 Target	2014 Actual
Value of Sales (USD)						d
Male						
Female						
Joint						
Association-applied						
Disaggregates Not Available						
Quantity of Sales (Measured using units selected above)						e
Male						
Female						
Joint						
Association-applied						
Disaggregates Not Available						
Purchased input costs (USD)						f
Male						
Female						
Joint						
Association-applied						
Disaggregates Not Available						

Interpreting Data. In the FTFMS sample screenshot of fictional data[79] (Figure 7), the reported increase in gross margin for maize between the baseline (USD 30/hectares) and 2014 (USD 159/hectares) could be a result of:

- An increase in yield (metric tons/hectares);
- An increase in unit value (USD/metric tons);
- A decrease in the per unit price of inputs (USD/metric tons); and
- A combination of any or all of the above.

[79] All FTFMS screenshots of fictional data for the four indicators are from the same fictional IM and can be used together to aid in interpretation of results.

Figure 7. FTFMS screenshot of data for gross margin

Indicator / Disaggregation	2014 Deviation Narrative	2014 Comment	Baselne Year	Baseline Value	2014 Target	Actual
4.5(16): Gross margin per unit of land, animal, or cage of selected product (crops/animals selected vary by country)*	Add	Add	2011			
Maize				30	127	159
Male				32	121	144
Female				22	139	189
Joint				30	116	115
Association-applied				0	0	0
Hectares planted (for crops); Number of animals (for milk, eggs); or Area (ha) of ponds or Number of crates (for fish)*				32,864	70,000	69,293
Male				19,061	38,500	34,108
Female				12,160	24,500	26,237
Joint				1,643	7,000	5,948
Association-applied				0	0	0
Disaggregates Not Available						
Total Production				31,065	81,602	73,245
Male				18,236	43,689	40,048
Female				11,271	34,004	29,199
Joint				1,558	3,309	3,998
Association-applied				0	0	0
Disaggregates Not Available						
Value of Sales (USD)				2,742,980	8,508,440	11,230,000
Male				1,837,797	4,994,955	6,470,300
Female				768,034	3,023,010	3,985,900
Joint				137,149	790,475	773,800
Association-applied				0	0	0
Disaggregates Not Available						
Quantity of Sales				13,265	32,589	37,433
Male				8,622	16,490	21,709
Female				3,979	13,445	12,753
Joint				664	2,625	2,971
Association-applied				0	0	0
Disaggregates Not Available						

Figure 7. FTFMS screenshot of data for gross margin (continued)

Indicator / Disaggregation	2014 Deviation Narrative	2014 Comment	Baseline Year	Baseline Value	2014 Target	2014 Actual
Purchased input costs (USD)				5,453,079	13,156,509	10,959,9190
Male				3,271,847	8,586,039	7,030,749
Female				1,908,577	4,219,573	3,571,174
Joint				272,655	350,897	357,996
Association-applied				0	0	0
Disaggregates Not Available						

*Production and quantity of sales data are reported here in metric tons. If reported in other units (e.g., kilograms, liters, number of animals sold), they need to be converted to metric tons for entry under incremental sales (4.5.2-23).

Although the total reported amount of maize produced is higher in 2014 (73,245 metric tons) than at baseline (31,065 metric tons), more hectares were also cultivated in 2014 (69,293 hectares) than at baseline (32,864 hectares). In order to determine whether maize productivity actually increased between baseline and 2014 or if the increase in production was the result of additional hectares being cultivated with maize, total production for each year is converted to yield (production/hectare) and compared. At baseline maize yield was .95 metric tons/hectares and in 2014 it was 1.1 metric ton/hectares, suggesting that maize productivity actually increased as a result of application of improved technologies or management practices by beneficiary farmers and that the increase in production was not just a result of cultivating more hectares.

Increased gross margin for maize between baseline and 2014 may also have been affected by price increases for maize. While the volume of maize sold doubled between baseline (13,265 metric tons) and 2014 (37,433 metric tons), the value of those sales more than quadrupled during the same timeframe (USD 2,742,980 at baseline compared to USD 11,230,000 in 2014), suggesting that more favorable prices for farmers may also have contributed to the overall increase in gross margin.

The average unit value at baseline was USD 207/metric tons (USD 2,742,980/13,265 metric tons) but increased to USD 300/metric tons in 2014 (USD 11,230,000/37,433 metric tons). This represents an increase of 50 percent, which could be due to improved market linkages and application of improved technology or practices by beneficiary farmers, or through factors beyond control of program interventions (e.g., increase in global food prices). Purchased input costs increased overall between baseline and 2014, which is consistent with the increase in the number of hectares cultivated. However, input costs per unit of production dropped from USD 176/metric tons at baseline to USD 150/metric tons in 2014. A reduction in per unit input costs (with a corresponding increase in gross margin) could result from either a reduction in the price of the inputs and/or a more efficient use of the inputs with respect to the commodity produced, in this case maize.

At baseline beneficiaries sold less than one-half of what they produced; 43 percent of the total amount produced at baseline was sold. The relative amount sold increased in 2014; 51 percent of total production was sold. Any remaining amounts were presumably consumed, stored or otherwise used. This suggests there may be ample opportunity for beneficiaries to increase sales even more by selling more of what they produce (unless prices decline). An increase in average market price for maize between baseline and 2014 may have incentivized beneficiary farmers to sell more of what they produced in 2014. Alternatively, increased productivity may have resulted in a surplus over what is used for home consumption, allowing for increased sales. Both would suggest some measure of success from Feed the Future activities.

I. Specific Challenges Regarding the Gross Margin Indicator

Challenges and suggested solutions associated with the collection and use of data for the gross margin indicators (4.5.-16, 17, 18) are presented below.

Problem	Response
What unit of measurement is used to calculate gross margin in aquaculture?	For pond aquaculture, gross margin of an aquaculture commodity (e.g., carp, shrimp) is calculated per hectare of pond surface area. For an open water aquaculture commodity, it is calculated per cage.
How is gross margin compared for different animals (e.g., goats and cattle)?	The unit of production for livestock is the number of animals involved in production, and thus could be used to compare between different livestock commodities as returns per animal. However, it may not be particularly meaningful to compare gross margins between certain types of livestock (e.g., chickens and cattle). Alternatively, it might be reasonable to compare returns per animal between goats and sheep if they compete for the same pasture.
What timeframe is used to report crops that have an extended production cycle (e.g., banana, cassava) or their production cycle straddles two reporting years?	The reporting timeframe is the fiscal year. For crops with an extended production cycle, production and other data required for gross margin (4.5-16) are best collected toward the end of the fiscal year (i.e., September). Collect production, sales, and input costs data over the previous 12 months, and then collect at the same time for the same reference period each year going forward. For crops with a production cycle that straddles two reporting years, total production (and all other data points relevant to that reporting cycle, e.g., input costs, sales, number of farmers applying improved technology/practices, and number of hectares) are reported during the second reporting year when all required data points are available, and clearly documented. Since the four key agricultural indicators (gross margins, number of farmers applying improved technologies, number of hectares under improved technologies, and incremental sales) are all related, you should report all four indicators in the second reporting year.

Problem	Response
	Initial data for production (and other data points) may be lower than subsequent recordings as they may represent no harvest or partial harvests in the first reporting year(s).
Is the gross margin indicator necessary and appropriate? It is difficult to monitor and calculate, and isn't necessarily used by farmers to determine which farm activities and products are most profitable.	Gross margin is an appropriate indicator for IPs to monitor the returns to farmers that can result from use of improved technology and management practices being disseminated through their program activities.
How is home consumption accounted for when calculating gross margin?	Record the total amount produced/harvested and sold. Post-harvest use or distribution of production (e.g., home consumption, land-use or debt payment) is included in the total value of production.
Can gross margin be calculated if a farmer does not sell any of his/her production?	For FTFMS reporting purposes, if no sales occur by any of the activity's beneficiaries, then gross margin cannot be calculated. Since FTFMS calculates gross margin using the five data points, each of which are summed across all beneficiaries, and since the volume and value of sales data points are only used to calculate an average price which is then used to value total production, all that is needed is for one beneficiary to have sold some of his/her production for gross margin to be calculated at the activity-level. However, using the average price received by one or a small proportion of beneficiaries to value the total production of all beneficiaries may not be advisable. Therefore, for activities in which agricultural components are not market-oriented but rather designed to increase farmer production for home consumption, gross margin may not be an appropriate performance indicator.
Can negative gross margin be reported, for example for perennial crops (e.g., tree crops) that may not be harvestable for several years?	Reporting should reflect actual results. Negative gross margin should be reported if that is what happened, and an explanation provided in the deviation narrative. A negative gross margin is not a problem per se; it may be negative in the early years of a project. It is important to a) reflect this in your targets and b) make sure your farmers have alternative sources of income to sustain themselves until they start receiving a net return from the crop(s). However, a negative gross margin can also signal a problem, such as lower than expected prices, higher than expected costs, or a change in market demand, that might require reassessment of a farmer's production strategies and activities.
How is gross margin calculated for different grades of a crop or	Gross margin (4.5-16) is not differentiated by grade in the FTFMS.

Problem	Response
livestock?	Grades or overall product quality are typically reflected in the sales price a farmer receives. Higher grades/quality products typically bring higher prices. As such, grade is reflected in gross margin.
Can gross margin be calculated at the household level rather than disaggregated by sex?	Gross margin (4.5-16) is reported for direct beneficiaries engaged in Feed the Future-promoted value chain activities and disaggregated by sex. If both the male and female in a household are direct beneficiaries of the project, they are each counted under the appropriate sex disaggregate for all data points in gross margin.

4.5.2-23 Incremental Sales

Value of incremental sales draws on two of the five data points required for gross margin. The indicator is measured at the farm-level and involves measuring the total amount of sales (in value and volume) from Feed the Future-promoted value-chain activities conducted by small-holder farmers/producers during the reporting year. Thus, it is a measure of gross revenue from Feed the Future target commodities. It does not reflect total household income as small-holder farmers and other producers may also sell products not attributable to Feed the Future interventions, may receive income from non-farm and non-agricultural sources, and may redistribute labor and other household resources in response to increased income from agriculture that may result in decreased income from other sources.

For any given farmer or producer, the reporting year sales (value and volume) of a specific commodity should be the same or similar for both incremental sales and gross margin, as both measures involve only those commodities attributable to Feed the Future programming. Several exceptions exist. For horticultural products, the values might differ between the indicators; incremental sales allows use of the "Horticulture" disaggregate which lumps all horticulture products together (i.e., one figure for volume of sales and one figure for value of sales, each summed across all horticulture products) whereas gross margin (4.5-16) requires IPs to report on individual horticultural commodities targeted by the activity (though they may report on only the top five horticulture products if direct beneficiaries cultivate a large number of horticultural products). For commodities from which byproducts (e.g., maize stalks) might also be sold, the value and volume of sales under incremental sales would be higher than that reported under gross margin, which should only include sales of the primary commodity (and value-added products) but not sales of byproducts (see section on *Measuring agricultural sales*).

What's Being Measured. Incremental sales measures the total sales by direct beneficiary farmers and other primary producers attributable to Feed the Future activities in a reporting year. Data on the total amount a farmer or producer sold (volume) and the total value of those sales are reported by commodity in each reporting year. The total reporting year sales value is then compared to a commodity-specific base-year sales value, based on sales prior to the Feed the Future activity.

However, the number of small-holder direct beneficiaries for a given commodity or value chain activity can change each year (e.g., new beneficiaries are added). New beneficiaries are not reflected in the base-year sales figure. Thus, reported increases in the value of incremental sales between the base-year and a given reporting year may simply reflect the increased number of beneficiaries participating in – and benefitting from – the Feed the Future activity, and thus overestimate incremental sales.

To address this issue, Feed the Future now requires reporting the number of direct beneficiaries for whom sales data are reported, along with reporting year sales. . FTFMS uses the baseline sales and baseline number of beneficiaries to establish average sales per beneficiary at baseline. The average baseline sales per beneficiary are multiplied by the number of beneficiaries in each reporting year to create an adjusted baseline sales value, which is then subtracted from reporting year sales to calculate the adjusted incremental sales value.

Variability in prices – whether from seasonal or annual fluctuations, where along the value chain sales occur, or project interventions (e.g., improved productivity or marketing) – can impact the value of sales. As currently measured and reported, it is impossible to completely tease apart these effects when interpreting results. Taking into account the number of direct beneficiaries in the baseline and reporting years will allow for subtracting estimated baseline sales for new beneficiaries from reporting year sales, and calculating an average incremental sale per beneficiary. This would reduce at least some ambiguity regarding sources of change reported in the global figure for incremental sales and might provide a project-level assessment of progress that is more relevant to the small-holder farmer or producer. Although not used directly in calculating the incremental sales indicator value, the volume of sales also helps interpret causes in reported increases in sales.

Calculating Baseline Year Sales. The value of incremental sales indicator requires collecting data on sales by direct beneficiaries that occurred prior to initiation of the Feed the Future activity. Baseline year sales allow for comparison of sales of Feed the Future-promoted commodities (crops, livestock or fish) in each reporting year with those from before the activity started. These comparisons, in turn, capture changes in sales by direct beneficiary farmers or other primary producers resulting from the activity.

It is ***absolutely essential that Baseline Year Sales and Baseline Direct Beneficiaries data points are entered for each commodity***. The Value of Incremental Sales indicator value cannot be calculated without a value for Baseline Year Sales and Beneficiaries.

Many IPs report difficulty measuring sales prior to Feed the Future implementation. In those cases where quantifying baseline year sales data for Feed the Future value chain commodities by direct beneficiaries is not possible, IPs should use the earliest reporting year sales data as the baseline year (i.e., do not leave blank or enter "0" into baseline year values, unless there were actually no sales of the commodity by beneficiaries before the activity began). This will result in underestimation of the total value of incremental sales over the life of the activity. As the alternative is not being able to calculate the indicator at all, such potential underestimation is acceptable to Feed the Future.

FTFMS Reporting. ***Annual reporting for this indicator requires entry of three data points for each commodity*** (Figure 8)***:*** reporting year value of sales (b, e), reporting year volume of sales (c, f), and reporting year number of direct beneficiaries involved in the commodity-specific activities (d, g). As noted above, the indicator requires "Baseline (Year) Sales" (a, h), which is only entered once. FTFMS will automatically calculate the commodity-specific value of incremental sales (i, j) by subtracting the adjusted baseline year sales (a, h) from reporting year sales (b, e).

FTFMS automatically calculates totals for adjusted baseline sales, baseline sales, reporting year sales, volume of sales and beneficiary numbers at the IM level (k), which reflects the sum across all commodities reported under incremental sales. After data entry, FTFMS calculates the indicator-level value of incremental sales (l) by subtracting aggregate Adjusted Baseline Sales from aggregate Reporting Year Sales.

Because the value of incremental sales indicator measures project-attributable change, ***a baseline value for the indicator itself (as opposed to the Baseline Year Sales data point) is not applicable***. The Baseline Value cell is left blank in FTFMS (m).

Figure 8. FTFMS data entry for value of incremental sales

Indicator / Disaggregation	2014 Deviation Narrative	2014 Comment	Baseline Year	Baseline Value	2014	
					Target	Actual
4.5.2(23): Value of incremental sales (collected at farm-level) attributed to FTF implementation	Add	Add		m		l
Total Adjusted Baseline sales						
Total Baseline sales						
Total Reporting year sales						k
Total Volume of sales (mt)						
Total Number of direct beneficiaries						
Maize						i
Adjusted Baseline Sales				a		
Baseline sales						
Reporting year sales						b
Volume of sales (mt)						c
Number of direct beneficiaries						d
Bananas						j
Adjusted Baseline Sales				h		
Baseline sales						
Reporting year sales						e
Volume of sales (mt)						f
Number of direct beneficiaries						g

Note sales of commodity-specific by-products.

Commodity-specific sales value and volume figures are often the same for incremental sales and for those reported under gross margin. If incremental sales include sales of by-products, use the Indicator Comment to explain why sales values for the two indicators differ.

When direct beneficiary sample surveys are used to collect value and volume of sales for target commodities from a sample of beneficiaries, estimates from the survey must be extrapolated to estimate total values for all direct beneficiaries involved in the commodity activities and then entered into FTFMS.

Interpreting Data. In the FTFMS sample screenshot in Figure 9, the reported value of incremental sales across the two value chains promoted by the activity is USD 12,103, 988 (the difference between the 2014 reporting year sales of USD 19,533,000 and the adjusted baseline year sales of USD 7,429,012). Without adjusting baseline sales to account for the increase in the number of beneficiaries, total incremental sales would have been 15,631,504 USD, a potential overestimate of more than 3 million USD.

Nearly 58 percent of total reporting year sales from the two value chains were of maize (USD 11,230,000/19,533,000). Note that for maize, sales reported in Figure 9 are the same values as those reported for sales of maize under gross margin (Figure 7), suggesting no sales of maize byproducts occurred.

Figure 9. FTFMS screenshot of data for value of incremental sales

Indicator / Disaggregation	2014 Deviation Narrative	2014 Comment	Baselne Year	Baseline Value	2014	
					Target	Actual
4.5.2(23): Value of incremental sales (collected at farm-level) attributed to FTF implementation	Add	Add			6,483,604	12,103,988
Total Adjusted Baseline sales					7,514,720	7,429,012
Total Baseline sales				3,901,496	3,901,496	3,901,496
Total Reporting year sales					13,998,324	19,533,000
Total Volume of sales (mt)					45,435	53,328
Total direct beneficiaries				29,828	53,980	53,946
Maize			2011			8,487,020
Adjusted Baseline sales					3,851,616	6,396,791
Baseline sales			2011	2,742,980	2,742,980	2,742,980
Reporting year sales					8,808,440	11,230,000
Volume of sales (mt)					32,589	37,433
Number of direct beneficiaries			2011	26,894	48,600	47,388
Banana			2011		2,631,988	5,707,198
Adjusted Baseline sales					2,557,896	2,595,802
Baseline sales			2011	1,158,516	1,158,516	1,158,516
Reporting year sales					5,189,884	8,303,000
Volume of sales (mt)					12,845	15,895
Number of direct beneficiaries			2011	2,934	6,478	6,574

At baseline, average sales per beneficiary were USD 102 for maize and USD 395 for banana, which increased to USD 237 and USD 1,263 for maize and banana, respectively, in 2014. Such results could reflect the effects of value chain activities (e.g., heavy/better marketing emphasis for the banana than the maize value chain activities), or the effects of factors beyond the control of the IM (e.g., higher banana prices resulting from lower world production due to disease) and should be discussed in the performance narrative.

I. Specific Challenges Regarding the Value of Incremental Sales Indicator

Challenges and suggested solutions associated with the collection and use of data for the incremental sales indicator (4.5.2-23) are presented below. Additional challenges associated with value and volume of sales generally are discussed in *Measuring Agricultural Sales*.

Problem	Response
Should negative incremental sales be reported (e.g., sales in the reporting year are less than in the baseline year)?	Reporting should reflect actual results. Negative incremental sales should be reported if that's what happened, and explained in the deviation narrative.
How is home consumption reported in incremental sales?	Incremental sales reflect only cash sales.

4.5.2-5 Number of Farmers and Others Applying Improved Technologies or Management Practices

Measuring beneficiary uptake of improved technology or management practices is one of the foundational ways of tracking progress toward the overarching Feed the Future goals of increasing productivity and reducing poverty. As the number of farmers applying improved technologies or practices reported under the 4.5.2-5 Value Chain Actor Type Producer disaggregate category increases, the number of hectares to which improved technologies and practices are applied is likely to increase, leading to an overall increase in productivity, sales and ultimately, household income.

What's Being Measured. This indicator measures the number of direct beneficiary primary producers (farmers, ranchers, fisherfolk, herders), entrepreneurs, managers, traders, processors (individuals only), natural resource managers, and others that are currently using improved technologies or management practices as a direct result of USG assistance. It refers explicitly to direct beneficiary farmers and others who are ***applying*** project-promoted improved technologies or practices and measures: (1) the total number of direct beneficiary producers and others applying improved technologies or practices, (2) the number of female and male direct beneficiary farmers and others applying improved technologies or practices, (3) the number of producer and non-producer direct beneficiaries applying improved technologies or practices, and (4) the number of direct beneficiary producers and others applying specific technologies or practices.

This indicator does ***not*** measure whether they have necessarily ***adopted*** improved technologies or practices. Thus, it does not provide a measure of the depth of technology uptake by direct beneficiaries but rather seeks to assess how many direct beneficiaries are risking that first step and trying something new.

The Technology Type disaggregate category "total with one or more improved technology/practice" captures the total number of farmers or others applying at least one Feed the Future-promoted technology or practice. It does not matter how many total improved technologies or practices are applied, as this disaggregate was not designed to capture some minimum number of technologies or practices that might be required for maximum improvement in production (or other results). Technology Type disaggregates allow tracking of coverage for specific technologies or practices and could be used to track coverage of some minimum "set" of technologies, assuming the reported number of hectares under each technology considered part of the "set" are equal. Thus, differential rates of uptake of specific types of technologies in the package could be tracked.

To determine how many improved technologies or management practices individual beneficiaries are applying, or how many beneficiaries are applying a minimum or entire set of technologies, custom indicators would need to be developed.

FTFMS Reporting. Data entry into FTFMS for number of beneficiary farmers and others applying improved technology or management practices is illustrated in Figure 10. Data is entered separately for Producers and for Others. Under each Value Chain Actor Type, data are entered for the Sex and Technology Type disaggregates. FTFMS automatically computes totals for the overall indicator value (c), for each Value Chain Actor Type (Producers and Others) (x and y, respectively), and for each disaggregate under each Value Chain Actor Type (Sex and Technology Type). The total number of Producer

"Double Counting" of Farmers

The number of farmers and others is not summed across all Technology Type disaggregate categories and therefore is not being "double counted" per se. Rather, farmers and other value chain actors are reported ***separately*** under each relevant technology disaggregate.

The Technology Type disaggregate includes a category "total with one or more improved technology." All IMs should report against this category ***in addition to*** the relevant specific Technology Type disaggregate categories (e.g., crop genetics, pest management) under which the activity-promoted technologies or practices fall.

The number of farmers and others reported under this disaggregate should equal the ***total number of direct beneficiaries applying at least one*** improved technology or management practice during the reporting year. Except in cases where the activity is promoting only one type of technology or practice, "total with one or more improved technology" will always be ***less*** than the sum of the beneficiary hectares reported under each specific Technology Type disaggregate category.

beneficiaries and of Other beneficiaries under the Technology Types disaggregate (a, and r, respectively) should equal the total number of Producers and of Others under the Sex disaggregate for each Actor Type (b, and s, respectively). FTFMS will not permit data to be saved if disaggregate totals do not match.

Figure 10. FTFMS data entry for number of farmers

Indicator / Disaggregation	2014 Deviation Narrative	2014 Comment	Baseline Year	Baseline Value	2014	
					Target	Actual
4.5(2): Number of farmers and others who have applied improved technologies or management practices as a result of USG assistance	Add	Add				c
Producers						x
Sex						b
Male						
Female						
Disaggregates Not Available						
Technology Type						a
crop genetics						
cultural practices						
livestock management						
wild fishing technique/gear						
aquaculture management						
pest management						
disease management						
soil-related fertility and conservation						
irrigation						
water management (non-irrigation)						
climate mitigation or adaptation						
marketing and distribution						
post-harvest – handling and storage						
value-added processing						
other						
total w/one or more improved technologies						
Disaggregates Not available						
Others						y
Sex						s
Male						
Female						
Disaggregates Not Available						
Technology Type						r
crop genetics						
cultural practices						
livestock management						
wild fishing technique/gear						
aquaculture management						
pest management						
disease management						

soil-related fertility and conservation						
irrigation						
water management (non-irrigation)						
climate mitigation or adaptation						
marketing and distribution						
post-harvest – handling and storage						
value-added processing						
other						
total w/one or more improved technologies						
Disaggregates Not available						

Interpreting Data. As beneficiary farmers and others are only counted once during the reporting year regardless of how many times they apply improved technology or management practices, 28,980 beneficiaries applied at least one improved technology or management practice during the 2014 reporting year (Figure 11), all of them were producers, and nearly equal numbers were male (15,620) as female (14,490).

However, the 2014 actual result falls far short of the 2014 target for number of beneficiary producers applying improved technologies or management practices. Comparing Technology Type targets to actuals, it appears beneficiaries are facing particular challenges in applying the soil-related fertility and conservation technologies and practices being promoted by the project, since only 25 percent of the targeted beneficiaries applying these technologies during the reporting year, compared with 52 to 80 percent for the other technology types being promoted. Assuming only maize and banana value chains comprise IM activities, comparison of the total number of direct beneficiaries reported under incremental sales in 2012 (53,946) with the number of beneficiaries applying an improved technology or practice in 2012 (28,980) suggests that many beneficiaries are not applying any improved technologies. The IP could use qualitative methods to determine what constraints beneficiaries are facing in applying the promoted technologies and practices in general and for the soil-related fertility and conservation ones in particular, and what adjustments the IM might make to address them.

Figure 11. FTFMS screenshot of data for number of farmers

Indicator / Disaggregation	2014 Deviation Narrative	2014 Comment	Baseline Year	Baseline Value	2014		2015
					Target	Actual	Target
4.5(2): Number of farmers and others who have applied improved technologies or management practices as a result of USG assistance	<u>Add</u>	<u>Add</u>	2011	8,500	48,500	28,980	53,980
Producer				8,500	48,500	28,980	53,980
Sex				8,500	48,500	28,980	53,980
Male				4,850	20,855	15,620	23,200
Female				3,650	27,645	14,490	30,780
Disaggregates Not							

Indicator / Disaggregation	2014 Deviation Narrative	2014 Comment	Baseline Year	Baseline Value	2014 Target	2014 Actual	2015 Target
Available							
Technology Type				8,500	48,500	28,980	53,980
crop genetics				350	23,000	12,000	30,000
cultural practices				7,000	35,000	27,000	50,000
livestock management							
wild fishing technique/gear							
aquaculture management							
pest management							
disease management							
soil-related fertility and conservation				1,875	30,000	7,500	40,000
irrigation							
water management (non-irrigation)							
climate mitigation or adaptation							
marketing and distribution							
post-harvest – handling and storage				100	25,000	20,000	40,000
value-added processing							
other							
total w/one or more improved technologies				8,500	48,500	28,980	53,980
Disaggregates Not available							
Others							
…rest of screen not shown							

1. Specific Challenges Regarding the Number of Farmers and Others Applying Improved Technologies or Management Practices Indicator

Many of the challenges associated with measuring this indicator are described under *Measuring Improved Technology or Management Practices*. Challenges and suggested solutions associated with the collection and use of data specific to the number of farmers and others indicator (4.5.2-5) are presented below.

Problem	Response
If a farmer is using improved maize seed on a part of his/her	Farmers are counted **once** during the reporting year under the relevant Sex disaggregate category and the "Total with one or

Problem	Response
land or in one season, and also using improved bean seed on another part of his/her land or in a second season, how is the farmer counted?	more" Technology Type disaggregate category, regardless of the number of improved technologies or practices applied. Farmers are also counted once under each relevant Technology Type category. In this example, the farmer would be counted once under the "Crop Genetics" category because both improved technologies applied involved improved seed. Because the beneficiary applied at least one improved technology in each season, the area is counted each time it is cultivated during the reporting year under number of hectares (4.5.2-2). For gross margin (4.5-16), area is counted each time it is cultivated, regardless of whether improved technologies or practices were applied.
How can IPs continue tracking farmers and others who graduate from the activity?	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.
How are polygamous households counted?	The indicator is calculated on an individual level. Each direct beneficiary that is cultivating or working with target crops should be counted. Marital status or arrangements are irrelevant.

4.5.2-2 Number of Hectares Under Improved Technologies or Management Practices

Increasing the number of hectares reported under 4.5.2-2 as applying improved technologies or management practices is a first step toward increasing agricultural productivity and reducing poverty. Certain livestock and fisheries technologies and management practices cannot be reported with this indicator as they are not land-based (i.e., applied to farmers' fields).

What's Being Measured. This indicator monitors changes in the number of hectares cultivated using Feed the Future-promoted improved technologies or management practices during the reporting year. Based on the way this indicator is disaggregated, it provides several measures: (1) the total number of hectares impacted by Feed the Future investments, (2) the number of hectares being managed using specific technologies or practices as a result of Feed the Future investments, and (3) the number of hectares on which males and females are applying improved technologies or practices as a result of Feed the Future investments.

The Technology Type disaggregate category "total with one or more improved technology/practice" captures the total number of hectares with at least one Feed the Future-promoted technology or practice being applied. It does not matter how many total improved technologies or practices are applied to an area, as this disaggregate was not designed to capture some minimum number of technologies or practices that might be required for maximum improvement in production (or other results). Technology Type disaggregates allow tracking of coverage for specific technologies or practices and could be used to track coverage of some minimum "set" of technologies, assuming the reported number of hectares under each technology considered part of the "set" are equal. Thus, differential rates of uptake of specific types of technologies in the package could be tracked.

Increasing productivity often involves more intensive use of area (i.e., more is produced on the same or less area). When the total number of hectares, or the number of hectares under at least one improved technology or management practices does not change significantly between reporting years, uptake of technology will be captured by changes in the number of hectares under a given type of technology or management practice. This may result when there is an upper limit to cultivable land (and it has been reached) or intensification is the goal rather than bringing additional land under cultivation.

"Double Counting" of Hectares

The number of hectares is not summed across all Technology Type disaggregate categories and therefore is not being "double counted" per se. Rather, hectares are reported ***separately*** under each relevant technology disaggregate.

The Technology Type disaggregate includes a category "total with one or more improved technology." All IMs should report against this category ***in addition to*** the relevant specific Technology Type disaggregate categories (e.g., crop genetics, pest management) under which the activity-promoted technologies or practices fall.

The number of hectares reported under this disaggregate should equal the ***total number of hectares cultivated with at least one*** improved technology by direct beneficiaries during the reporting year. Except in cases where the activity is promoting only one type of technology or practice, "total with one or more improved technology" will always be ***less*** than the sum of the hectares reported under each specific Technology Type disaggregate category.

Disaggregation Categories

Sex Disaggregates. A "joint" category is included under the Sex disaggregate for this indicator. "Joint" is appropriate when male and female beneficiary farmers share in decision-making regarding the use of land. ***"Joint" is not applicable to situations in which a male makes the management decisions about the land and a female provides labor.*** In this case, the appropriate Sex disaggregate category would be "male."

The "association-applied" Sex disaggregate category is appropriate for projects that work with groups or associations (e.g., farmers' groups, women's groups, cooperatives) whose members are jointly applying improved technologies or practices on common ground (e.g., demonstration or training plots). The area of the common ground is counted as "association-applied." The group would be counted as one (1) under 4.5.2-42[80] and not under number of farmers and others (4.5.2-5). However, ***if individual group members "take home" and apply to their own land the improved technology or practice, then they should be counted (by sex) under the number of farmers and others (4.5.2-5) and their own area counted under this indicator (4.5.2-2).***

Technology and Management Practice Type Disaggregates. Non-land-based technology and management practice categories are not included because they cannot be measured by the number of hectares on which they are applied:

- Animal genetics;
- Post-harvest handling and storage;
- Processing; and
- Fishing gear/technique.

IPs should determine how the technology or practice being promoted by their programming is best classified. The "Other" category can be used when the Technology Type disaggregate categories do not capture the technology or practice being promoted through your programming. The activity-specific technologies or practices captured under "Other" should be described in the indicator notes.

If the activity is promoting more than one improved technology or management practice that would be reported in the same Technology Type disaggregate category (e.g., Pest management), the area to which the technology or practice is applied is only counted ***once*** when reporting in FTFMS. However, it is important for project management purposes to track separately each technology applied in order to determine whether barriers exist to application of individual technologies or practices.

FTFMS Reporting. When entering data into FTFMS, the number of hectares under each specific type of technology or management practice promoted through the Feed the Future activity is reported under the appropriate Technology Type disaggregate category (a) (Figure 12). The total number of hectares that are managed under at least one improved technology or practice is entered in the "total with one or more improved technology" disaggregate (b), which should equal the total of the Sex disaggregate (d). They should also equal the total of the Technology Type disaggregate (c)

[80] Number of private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and CBOs that applied new technologies or management practices as a result of USG assistance.

as well as the overall indicator value (e). FTFMS automatically calculates (c), (d), and (e) and will not permit data to be saved if disaggregate totals do not match. The figures reported for the Technology Type disaggregates (a) are not summed for reporting under this indicator.

Figure 12. FTFMS data entry for number of hectares

Indicator / Disaggregation	2014 Deviation Narrative	2014 Comment	Baseline Value	2014 Target	2014 Actual
4.5.2(2): Number of hectares under improved technologies or management practices as a result of USG assistance	Add	Add			e
Technology type					c
Crop genetics					
Cultural practices					
Pest management					↑
Disease management					
Soil-related					a
Irrigation					
Water management					↓
Climate mitigation or adaptation					
Other					
Total w/one or more improved technology					b
Disaggregates Not Available					
Sex					d
Male					
Female					
Joint					
Association-applied					
Disaggregates Not Available					

Interpreting Data. In Figure 13, a total of 25,804 hectares was under at least one improved technology or management practice in the 2014 reporting year. Consistent with how the indicator is defined, the sum of the number of hectares reported in each of the Technology Type disaggregate categories in 2014 (7,814+7,526+12,739+4,206=32,284) does not equal the total number of hectares under one or more improved technology or management practices (25,804). This underscores the "double-reporting" rather than "double-counting" of hectares under the Technology Type disaggregate.

From Figure 11 we see that in 2014, 28,980 direct beneficiary farmers and others applied at least one improved technology or management practice and from Figure 13 we see that at least one improved technology or practice was applied to 25,804 hectares. Unfortunately, we cannot determine an average plot size per direct beneficiary from these two data sources because we do not know that all beneficiaries reported under 4.5.2-5 only applied land-based technologies or practices (i.e., measured by hectares). Nor can we determine from these four indicator screenshots how much of the 51,593 hectares on which maize was produced (Figure 13) was grown using at least one improved technology or management practice. However, the IM ***can*** make such determinations because they, in fact, have such information regarding direct beneficiaries, and should be utilizing it in the narrative to help explain the results. We can, however, deduce that ample opportunity exists to improve maize production through application of improved technologies or management practices, as only 25,804 hectares across all crops are currently managed with improved technology or practices.

Figure 13. FTFMS screenshot of data for number of hectares

Indicator / Disaggregation	2014 Deviation Narrative	2014 Comment	Baseline Value	2014 Target	2014 Actual	2015 Target
4.5.2(2): Number of hectares under improved technologies or management practices as a result of USG assistance	Add	Add	4,250	25,804	25,804	37,006
Technology type			4,250	25,804	25,804	37.006
Crop genetics			2,344	7,814	7,814	10,989
Cultural practices						
Pest management			690	7,526	7,526	10,794
Disease management						
Soil-related			1351	12,739	12,739	18,270
Irrigation						
Water management						
Climate mitigation or adaptation						
Other			1743	4,206	4,206	6,031
Total w/one or more improved technology			4,250	25,804	25,804	37,006
Disaggregates Not Available						
Sex			4,250	25,804	25,804	37,006
Male			2,508	12,128	12,386	16,098
Female			1,615	13,676	13,418	20,908
Joint			527	0	527	0
Association-applied				0	0	0
Disaggregates Not Available						

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Appendix 1. Oct 2014 revised PIRS for the Four Key Indicators

SPS LOCATION: Program Area 4.5: Agriculture
INITIATIVE AFFILIATION: Feed the Future – IR 1: Improved Agricultural Productivity

INDICATOR TITLE: 4.5(16,17,18) Gross margin per hectare, animal or cage of selected product (RiA)

DEFINITION:

The gross margin is the difference between the total value of small-holder production of the agricultural product (crop, milk, eggs, meat, live animals, fish) and the cost of producing that item, divided by the total number of units in production (hectares of crops, number of animals for milk, eggs; pond area in hectares for pond aquaculture or cage count for open water aquaculture). Gross margin per hectare, per animal, or per cage, is a measure of net income for that farm/livestock/fisheries-use activity.

Gross margin is calculated from five data points, reported as totals across all IM direct beneficiaries:

1. Total Production by direct beneficiaries during reporting period (TP)
2. Total Value of Sales (USD) by direct beneficiaries during reporting period (VS)
3. Total Quantity (volume) of Sales by direct beneficiaries during reporting period (QS)
4. Total Recurrent Cash Input Costs (USD) of direct beneficiaries during reporting period (IC)
5. Total Units of Production: Hectares planted (for crops); Number of Animals in herd/flock/etc. (for milk, eggs, meat, live animals); Area in ha (for aquaculture ponds) or Number of Cages (for open water aquaculture) for direct beneficiaries during the production period (UP)

Partners should enter disaggregated values for the five gross margin data points, disaggregated first by commodity, then by the sex disaggregate categories: male, female, joint and association-applied, as applicable. Commodity-sex layered disaggregated data are required because the most meaningful interpretation and use of gross margin information is at the specific commodity level, including the comparison of gross margins received by female and male farmers. FTFMS will then use the formula below to automatically calculate the average commodity-specific Gross Margin, and the average commodity-specific Gross Margin for each sex disaggregate:

Gross margin per ha, per animal, per cage = [(TP x VS/QS) – IC] / UP

For example, for the total production data point, partners should enter total production during the reporting year on plots managed by female, maize-producing, direct beneficiaries; total production on plots managed by male, maize-producing, direct beneficiaries; total production during the reporting year on plots managed jointly by female and male maize-producing, direct beneficiaries, if applicable; and total production on plots managed by groups ("association-applied") of maize-producing, direct beneficiaries; if applicable. And so forth for total value and total quantity of sales; total cash recurrent input costs; and total hectares, animals or cages for maize. And so forth for other commodities. The FTFMS will automatically calculate weighted (by total hectares, animals or cages) average gross margin per ha, animal or cage for the overall commodity (e.g. gross margin/hectare for maize) and for each sex disaggregate category (e.g. gross margin/hectare for female maize-producing direct beneficiaries.)

If a direct beneficiary sample survey is used to collect gross margin data points, the sample survey estimates must be extrapolated to total beneficiary estimated values before entry into FTFMS to ensure accurate calculation of weighted average gross margin per commodity across implementing mechanisms at the Operating Unit level and across countries for Feed the Future overall reporting.

Note: Gross margin targets should be entered at the commodity level. Targets do not need to be set for each of the five data points.

If there is more than one production cycle in the reporting year, farmer's land area should be counted (and summed) each time it is cultivated, and the other four data points (Total Production, Value and Quantity of Sales, Recurrent Cash Input Costs) summed across production cycles if the same crop was planted.

If the production cycle from soil preparation/planting to sales starts in one fiscal year and ends in another, report gross margin in the second fiscal year, once all data points are available. Since the four key agricultural indicators (gross margins, number of farmers applying improved technologies, number of hectares under improved technologies, and incremental sales) are all related, report all four indicators in the second fiscal year in these cases.

The unit of measure for Total Production (e.g. kg, mt, liter) must be the same as the unit of measure for Total Quantity of Sales, so that the average unit value calculated by dividing sales value by sales quantity can be used to value total production (TP x VS/QS). If sales quantity was recorded in a different unit of measure than the unit used for total production, sales quantity must be converted to the equivalent quantity in production units prior to entry in FTFMS. For example, if Total Production was measured in metric tons, and Total Quantity of Sales was measured in kg, Total Quantity of Sales should be divided by 1,000 before entering in FTFMS.

Also, if the form of the commodity varies between how it was harvested/produced and how it was sold, e.g. shelled peanuts are harvested but unshelled peanuts are sold, the sales form must be converted to its equivalent in the harvested/produced form prior to entry in FTFMS. For example, in Malawi, the extraction rate for shelled from unshelled peanuts is 65%. So if 1,500 kg of shelled peanuts were sold, this is equivalent to 2,304 kg of unshelled peanuts, and 2,304 should be entered as sales quantity, not 1,500, assuming that total production was measured in kg of unshelled peanuts. Country-specific extraction rates for a range of value-added commodities may be found at http://www.fao.org/fileadmin/templates/ess/documents/methodology/tcf.pdf.

Input costs included should be those significant cash costs that can be easily ascertained. Attention should be focused on accounting for cash costs that represent at least 5% of total cash costs. (Note, it is not necessary to calculate actual percent contribution of specific inputs to total input costs to determine which inputs account for at least 5% of total cash costs. Partners may simply estimate which inputs would qualify.) Most likely cash input cost items are: purchased water, fuel, electricity, seed, feed or fish meal, fertilizer, pesticides, hired labor, hired enforcement, and hired machine/veterinary services. Capital investments and depreciation should not be included in cash costs. Unpaid family labor, seed from a previous harvest and other in-kind inputs do not have to be valued and should not be included in costs.

The FTFMS will also automatically calculate the three PPR gross margin indictors listed under UNIT below by calculating operating-unit-level weighted average gross margin per hectare (includes crops and pond-based aquaculture), per animal and per cage across all relevant commodities reported by operating unit's IMs for

entry into FactsInfo. Caution should be exercised when interpreting the PPR indicators, however, because non-commodity-specific average gross margin across substantially different commodities (e.g. gross margin for live cows and gross margin for eggs, for maize and for basil, for irrigated and for rain-fed rice, for maize and for pond aquaculture fish) could be meaningless or misleading. Missions are encouraged to use the FTFMS commodity-sex-specific data to understand and report on gross margins. Please refer to the Feed the Future Agricultural Indicators Guide (http://agrilinks.org/library/feed-the-future-ag-indicators-guide) for additional guidance on collecting and interpreting the data required for this indicator.	
RATIONALE: Improving the gross margin for farm commodities for small-holders contributes to increasing agricultural GDP, will increase income, and thus directly contribute to the IR of improving production and the goal indicator of reducing poverty. Gross margin of fisheries is an appropriate measure of the productivity of a fishery and the impacts of fisheries management interventions.	
UNIT: dollars/hectare (crops, aquaculture in ponds); dollars/animal (milk, eggs, live animals, meat); or dollars/cage (open-water aquaculture) *Note: Convert local currency to USD at the average market foreign exchange rate for the reporting year or convert periodically throughout the year if there is rapid devaluation or appreciation.* *FTFMS notes:* *Enter the five data points into FTFMS for baseline and actual reporting. Enter unit of measure of quantity for total production and volume of sales data points. Data should be entered disaggregated to the lowest level – i.e. by commodity then by sex under each commodity. FTFMS will calculate gross margin per ha, animal or cage automatically. This calculation cannot be done without all five data points.* *FTFMS will produce a PPR report that aggregates commodity-specific gross margins data into the three FACTSInfo gross margin indicators:* *4.5-16 Farmer's gross margin per unit of land* *4.5-17 Farmer's gross margin per unit of animal* *4.5-18 Farmer's gross margin per crate*	*DISAGGREGATE BY:* Targeted commodity (type of crop, type of animal or animal product, or type of fish – freshwater or marine). *Gross margin should be reported separately for horticultural products; the general "Horticulture" category should not be used. If a large number of horticultural crops are being produced and tracking gross margin for each is too difficult, gross margins may be reported for the five (5) most commonly produced horticultural products.* Sex of farmer: Male, Female, Joint, Association-applied. *Note, before using the "Joint" sex disaggregate category, partners must determine that decision-making about what to plant on the plot of land and how to manage it for that particular beneficiary and targeted commodity is truly done in a joint manner by male(s) and female(s) within the household. Given what we know about gender dynamics in agriculture, "joint" should not be the default assumption about how decisions about the management of the plot are made.*
TYPE: Outcome	*DIRECTION OF CHANGE:* Higher is better
DATA SOURCE: Implementing partners	
MEASUREMENT NOTES: Additional data elements can be collected so Missions and partners can calculate productivity of other factors of production. For example, water consumption in cubic meters can be collected and used in the denominator to calculate water productivity, which is important in irrigated areas, and total labor used can be collected and used to calculate labor productivity in labor-scarce settings.	

- LEVEL OF COLLECTION: Activity-level, direct beneficiaries, targeted commodity/fisheries/livestock product
- DATA FOR THIS INDICATOR: Implementing partners
- HOW SHOULD IT BE COLLECTED: Direct beneficiary farmer/fisher/rancher sample surveys; data collection through producer organizations or farm records, routine activity records
- FREQUENCY OF COLLECTION: Annually.

SPS LOCATION: Program Element 4.5.2: Agricultural Sector Capacity
INITIATIVE AFFILIATION: Feed the Future – IR 1: Improved Agricultural Productivity / Sub IR 1.2: Enhanced Technology Development, Dissemination, Management and Innovation

INDICATOR TITLE: 4.5.2(2) Number of hectares under improved technologies or management practices as a result of USG assistance (RiA) (WOG) *

DEFINITION:
This indicator measures the area (in hectares) of land cultivated using USG-promoted improved technology(ies) or management practice(s) during the current reporting year. Technologies to be counted here are agriculture-related, **land-based** technologies and innovations including those that address climate change adaptation and mitigation. The indicator does not count application of improved technologies in aquaculture ponds, even though area of ponds is measured in hectares for *4.5(16,17,18) Gross Margins*. Significant improvements to existing technologies should be counted.

Examples of relevant technologies include:

- Crop genetics: e.g. improved/certified seed that could be higher-yielding, higher in nutritional content (e.g. through biofortification, such as vitamin A-rich sweet potatoes or rice, or high-protein maize) and/or more resilient to climate impacts; improved germ plasm.
- Cultural Practices: e.g. seedling production and transplantation; cultivation practices such as planting density, moulding; mulching.
- Pest management: e.g. Integrated Pest Management; appropriate application of insecticides and pesticides
- Disease management: e.g. improved fungicides, appropriate application of fungicides
- Soil-related fertility and conservation: e.g. Integrated Soil Fertility Management, soil management practices that increase biotic activity and soil organic matter levels, such as soil amendments that increase fertilizer-use efficiency (e.g. soil organic matter); fertilizers, erosion control
- Irrigation: e.g. drip, surface, sprinkler irrigation; irrigation schemes
- Water management: non-irrigation-based e.g. water harvesting
- Climate mitigation or adaptation: e.g. conservation agriculture, carbon sequestration through low- or no-till practices no-till practices
- Other: e.g. improved mechanical and physical land preparation.

If a beneficiary **cultivates a plot of land more than once in the reporting year**, the area should be counted each time it is cultivated with one or more improved technologies during the reporting year. For example, because of access to irrigation as a result of a Feed the Future activity, a farmer can now cultivate a second crop during the dry season in addition to her/his regular crop during the rainy season. If the farmer applies Feed the Future promoted technologies to her/his plot during both the rainy season and the dry season, the area of the plot would be counted twice under this indicator. However, the farmer would only be counted once under *4.5.2(5) number of farmers and others who have applied improved technologies.*

If a group of **beneficiaries cultivate a plot of land as a group**, e.g. an association has a common plot on which multiple association members cultivate together, and on which improved technologies are applied, the area of the communal plot should be counted under this indicator and recorded under the sex disaggregate "association-applied", and the group of association members should be counted once under *4.5.2(42) Number of private enterprises, producers organizations… and community-based organizations (CBOs) that applied improved technologies.*

If a lead **farmer cultivates a plot used for training**, e.g a **demonstration plot** used for Farmer Field Days or Farmer Field School, the area of the demonstration plot should be counted under this indicator, and the farmer counted under *4.5.2(5) number of farmers and others who have applied improved technologies.* However, if the demonstration or training plot is cultivated by extensionists or researchers, e.g. a demonstration plot in a research institute, neither the area nor the extensionist/researcher should be counted under the respective indicators.

Technology Type Disaggregation: If more than one improved technology is being applied on a hectare, count the hectare under each technology type (i.e. double-count). In addition, count the hectare under the total w/one or more improved technology category. Since it is very common for Feed the Future activities to promote more than one improved technology, not all of which are applied by all beneficiaries at once, this approach allows Feed the Future to accurately track and count the uptake of different technology types, and to accurately count the total number of hectares under improved technologies.

For example: An activity supports dissemination of improved seed, Integrated Pest Management and drip irrigation. During the reporting year, a total of 1,000 hectares were under improved technologies: 800 with improved seed, 600 with IPM and 950 with drip irrigation. FTFMS Technology Type disaggregate data entry would be as follows:

Technology type	
crop genetics	800
cultural practices	
pest management	600
disease management	
soil-related	
irrigation	950
water management	
climate mitigation or adaptation	
other	
total w/one or more improved technology	1000

Please refer to the Feed the Future Agricultural Indicators Guide (http://agrilinks.org/library/feed-the-future-ag-indicators-guide) for additional guidance on collecting and interpreting the data required for this indicator.

RATIONALE:
Tracks successful application of technologies and management practices in an effort to improve agricultural productivity, agricultural water productivity, sustainability, and resilience to climate impacts.

UNIT: Hectares	*DISAGGREGATE BY:* Technology type (see explanation in definition, above): Crop genetics, Cultural practices, Pest management, Disease management, Soil-related fertility and conservation, Irrigation, Water management, Climate mitigation or adaptation, Other; total w/one or more improved technology

<table>
<tr><td></td><td><u>Sex</u>: Male, Female, Joint, Association-applied
Note, before using the "Joint" sex disaggregate category, partners must determine that decision-making about what to plant on the plot of land and how to manage it for that particular beneficiary and targeted commodity is truly done in a joint manner by male(s) and female(s) within the household. Given what we know about gender dynamics in agriculture, "joint" should <u>not</u> be the default assumption about how decisions about the management of the plot are made.

Note: The sum of hectares under the Sex disaggregate should equal the total under the "Total w/ one or more improved technology" Technology Type disaggregate.</td></tr>
<tr><td>TYPE:
Outcome</td><td>DIRECTION OF CHANGE:
Higher is better</td></tr>
<tr><td colspan="2">DATA SOURCE:
Implementing Partners will collect this data through census or survey of direct beneficiaries, direct observations of land, farm records, and activity documents.</td></tr>
<tr><td colspan="2">MEASUREMENT NOTES:
➢ LEVEL OF COLLECTION: Activity-level, direct beneficiaries; only those hectares affected by USG assistance, and only those newly brought or continuing under improved technologies/management during the current reporting year
➢ WHO COLLECTS DATA FOR THIS INDICATOR: Implementing partners
➢ HOW SHOULD IT BE COLLECTED: Via survey or other applicable method
➢ FREQUENCY OF COLLECTION: Annually reported</td></tr>
</table>

SPS LOCATION: Program Element 4.5.2: Agricultural Sector Capacity
INITIATIVE AFFILIATION: Feed the Future – IR 1: Improved Agricultural Productivity / Sub IR 1.1: Enhanced human and institutional capacity development for increased sustainable agriculture sector productivity

INDICATOR TITLE: 4.5.2(5) Number of farmers and others who have applied improved technologies or management practices as a result of USG assistance (RiA) (WOG) *

DEFINITION:
This indicator measures the total number of **direct** beneficiary farmers, ranchers and other primary sector producers (of food and non-food crops, livestock products, wild fisheries, aquaculture, agro-forestry, and natural resource-based products), as well as individual processors (not firms), rural entrepreneurs, traders, natural resource managers, etc. that applied improved technologies anywhere within the food and fiber system as a result of USG assistance during the reporting year. This includes innovations in efficiency, value-addition, post-harvest management, marketing, sustainable land management, forest and water management, managerial practices, and input supply delivery. Technologies and practices to be counted here are agriculture-related, including those that address climate change adaptation and mitigation (including, but not limited to, carbon sequestration, clean energy, and energy efficiency as related to agriculture). Significant improvements to existing technologies and practices should be counted.

Examples for listed technology type disaggregates include:
- **Crop Genetics**: e.g. improved/certified seed that could be higher-yielding, higher in nutritional content (e.g. through bio-fortification, such as vitamin A-rich sweet potatoes or rice, or high-protein maize, or drought tolerant maize, or stress tolerant rice) and/or more resilient to climate impacts; improved germ plasm.
- **Cultural Practices**: e.g. seedling production and transplantation; cultivation practices such as planting density, moulding; mulching.
- **Livestock Management**: e.g. improved livestock breeds; livestock health services and products such as vaccines; improved livestock handling practices.
- **Wild Fishing Technique/Gear**: e.g. sustainable fishing practices; improved nets, hooks, lines, traps, dredges, trawls; improved hand gathering, netting, angling, spearfishing, and trapping practices.
- **Aquaculture Management**: e.g. improved fingerlings, improved feed and feeding practices, fish disease control, pond culture, pond preparation, sampling & harvesting, carrying capacity & fingerling management.
- **Pest Management**: e.g. Integrated Pest Management, improved insecticides and pesticides, improved and environmentally sustainable use of insecticides and pesticides.
- **Disease Management**: e.g. improved fungicides, appropriate application of fungicides.
- **Soil-related Fertility and Conservation**: e.g. Integrated Soil Fertility Management; soil management practices that increase biotic activity and soil organic matter levels, such as soil amendments that increase fertilizer-use efficiency (e.g. soil organic matter); improved fertilizer; improved fertilizer use practices; erosion control.
- **Irrigation**: e.g. drip, surface, and sprinkler irrigation, irrigation schemes.
- **Water Management - non-irrigation-based**: e.g. water harvesting, sustainable water use practices, improved water quality testing practices.
- **Climate Mitigation or Adaptation**: e.g. conservation agriculture; carbon sequestration through low- or no-till practices; increased use of climate information for planning, risk reduction, and increasing resilience; increased energy efficiency; natural resource management practices that increase resilience to climate change.
- Marketing and Distribution: e.g. contract farming technologies and practices, improved input purchase

technologies and practices, improved commodity sale technologies and practices, improved market information system technologies and practices.
- **Post-harvest - Handling & Storage**: e.g. improved packing house technologies and practices, improved transportation, decay and insect control, temperature and humidity control, improved quality control technologies and practices, sorting and grading.
- **Value-Added Processing**: e.g. improved packaging practices and materials including biodegradable packaging, food and chemical safety technologies and practices, improved preservation technologies and practices.
- **Other**: e.g. improved mechanical and physical land preparation, non-market-related information technology, improved record keeping, improved budgeting and financial management.

Note there is some overlap between the disaggregates listed here and those listed under *4.5.2(2) Number of hectares under improved technologies or management practices as a result of USG assistance.* This overlap is limited to the technologies and practices that relate to activities focused on land. The list of disaggregates here is much broader because with this indicator we are aiming to track efforts focused on individuals (as opposed to land area) across the value chain in land **and** non-land based activity.

For the Sex disaggregate and the Total with one or more improved technology/practice disaggregate category, a beneficiary is counted **once regardless of the number of technologies applied during the reporting year**. If **more than one beneficiary in a household** is applying improved technologies, count each beneficiary in the household who does so.

However, under the **Technology Type Disaggregation,** if the beneficiary applied more than one improved technology, count the beneficiary under <u>each</u> technology type (i.e. double-count). In addition, count the beneficiary once under the total w/one or more improved technology category. Since it is very common for Feed the Future activities to promote more than one improved technology, not all of which are applied by all beneficiaries at once, this approach allows Feed the Future to accurately track and count the uptake of different technology types, <u>and</u> to accurately count the total number of farmers applying improved technologies. See *4.5.2(2)* for an example of how to double-count hectares and farmers.

If a beneficiary **cultivates a plot of land more than once in the reporting year**, s/he should be counted once under each type of technology if s/he applied the improved technology during <u>any</u> of the production cycles during the reporting year. S/he should <u>not</u> be counted each time the same improved technology is applied. For example, because of new access to irrigation as a result of a Feed the Future activity, a farmer can now cultivate a second crop during the dry season in addition to her/his regular crop during the rainy season. If the farmer applies Feed the Future promoted improved seed to her/his plot during one season and not the other, or in both the rainy season and the dry season, s/he would only be counted once under the Crop Genetics technology type disaggregate category. However, the area under improved seed should be counted <u>each time</u> it is cultivated under *4.5(16,17,18) Gross margin per unit of land* and *4.5.2(2) number of hectares of land under improved technologies.*

Beneficiaries who are part of a group and apply improved technologies on a demonstration or other **common plot** with other beneficiaries, **are not counted as having individually applied an improved technology** The group should be counted as one (1) beneficiary group and reported under *4.5.2(42) Number of private enterprises, producers organizations… and community-based organizations (CBOs) that applied improved technologies* . The area of the communal plot should be counted under *4.5(16,17,18) Gross margin per unit of land* and *4.5.2(2) Number of hectares of land under improved technologies.*

If a **lead farmer cultivates a plot used for training**, e.g a demonstration plot used for Farmer Field Days or Farmer Field School, the beneficiary farmer should be counted under this indicator, and the area of the demonstration plot counted under *4.5(16) Gross margin per unit of land*, if applicable and *4.5.2(2) number of hectares of land under improved technologies.* However, if the demonstration or training plot is cultivated by extensionists or researchers, e.g. a demonstration plot in a research institute, neither the area nor the extensionist/researcher should be counted under the respective indicators. This indicator, *4.5.2(5)*, counts **individuals** who applied improved technologies, whereas indicator *4.5.2(28) Number of private enterprises, producers organizations…and community-based organizations (CBOs) that applied improved technologies or management practices* counts firms, associations, or other **group entities** applying association- or organization-level improved technologies or practices. *4.5.2(5) Number of farmers and others applying technologies/practices* individual-level indicator should <u>not</u> count all members of an organization as having applied a technology or practice just because the technology/practice was applied by the group entity. For example, a producer association implements a new computer-based accounting system during the reporting year. The association would be counted as having applied an improved technology/practice under *4.5.2(42) Number of private enterprises, producers organizations…applying* indicator, but the members of the producer association would <u>not</u> be counted as having individually-applied an improved technology/practice under 4.5.2(5) *Number of farmers and others applying technologies/practices* individual-level indicator. However, there are scenarios where both the group entity and its members can be counted, the group counted once under *4.5.2(42)* and individual members that applied the technology/practice under *4.5.2(5)*. For example, a producer association purchases a dryer and then provides drying services for a fee to its members. The producer association can be counted under *4.5.2(42)* and any association member that uses the dryer service can be counted as applying an improved technology/practice under *4.5.2(5)*. Please refer to the <u>Feed the Future Agricultural Indicators Guide</u> (http://agrilinks.org/library/feed-the-future-ag-indicators-guide) for additional guidance on collecting and interpreting the data required for this indicator.		
RATIONALE: Technological change and its adoption by different actors in the agricultural supply chain will be critical to increasing agricultural productivity, which is the Intermediate Result under which this indicator falls.		
UNIT: Number	*DISAGGREGATE BY:* <u>Value chain actor type</u>: -Producers (e.g. farmers, ranchers, and other primary sector producers of food and non-food crops, livestock products, wild fisheries, aquaculture, agro-forestry, and natural resource-based products) -Others (e.g. individual processors (but not firms),rural entrepreneurs, traders, natural resource managers, extension agents). <u>Technology type</u> (see explanation in definition, above): Crop genetics, Cultural practices, Livestock management, Wild fishing technique/gear, Aquaculture management, Pest management, Disease management, Soil-related fertility and conservation, Irrigation, Water management-non-irrigation based, Climate mitigation or adaptation, Marketing and distribution, Post-harvest – handling & storage, Value-added processing, Other; Total w/one or more improved technology/practice. <u>Sex</u>: Male, Female	
TYPE: Outcome		*DIRECTION OF CHANGE:* Higher is better

DATA SOURCE: Implementing Partners
MEASUREMENT NOTES: ➢ LEVEL OF COLLECTION: Activity-level, direct beneficiaries ➢ WHO COLLECTS DATA FOR THIS INDICATOR: Implementing partners ➢ HOW SHOULD IT BE COLLECTED: Sample survey of direct beneficiaries, activity or association records, farm records ➢ FREQUENCY OF COLLECTION: Annually reported

SPS LOCATION: Program Element 4.5.2: Agricultural Sector Capacity
INITIATIVE AFFILIATION: Feed the Future – IR2: Expanding Markets and Trade

INDICATOR TITLE: 4.5.2(23) Value of incremental sales (collected at farm-level) attributed to Feed the Future implementation (RiA)

DEFINITION:
This indicator will collect both volume (in metric tons) and value (in US dollars) of purchases from small-holder direct beneficiaries of targeted commodities for its calculation. This includes all sales by the small-holder direct beneficiaries of the targeted commodity(ies), not just farm-gate sales. Only count sales in the reporting year attributable to the Feed the Future investment, i.e. where Feed the Future assisted the individual farmer directly. Examples of Feed the Future assistance include facilitating access to improved seeds and other inputs and providing extension services, marketing assistance or other activities that benefited small-holders.

The value of incremental sales indicates the value (in USD) of the total amount of targeted agricultural products sold by small-holder direct beneficiaries relative to a base year and is calculated as the total value of sales of a product (crop, animal, or fish) during the reporting year minus the total value of sales in the base year.

The number of direct beneficiaries of Feed the Future activities often increases over time as the activity rolls-out. Unless an activity has identified all prospective direct beneficiaries at the time the baseline is established, the baseline sales value will only include sales made by beneficiaries identified when the baseline is established during the first year of implementation. The baseline sales value will not include the "baseline" sales made prior to their involvement in the Feed the Future activity by beneficiaries added in subsequent years. Thus the baseline sales value will underestimate total baseline sales of all beneficiaries, and consequently overestimate incremental sales for reporting years when the beneficiary base has increased. To address this issue, Feed the Future requires **reporting the number of direct beneficiaries for each value chain commodity along with baseline and reporting year sales**. FTFMS uses the baseline sales and baseline number of beneficiaries to establish average sales per beneficiary at baseline. The average sales per beneficiary are multiplied by the number of beneficiaries in each reporting year to create an adjusted baseline sales value. To accurately estimate out-year targets for incremental sales, targets for number of beneficiaries are also required.

It is **absolutely essential that a Baseline Year Sales data point is entered**. The Value of Incremental Sales indicator value cannot be calculated without a value for Baseline Year Sales. If data on the total value of sales of the value chain commodity by direct beneficiaries prior to Feed the Future activity implementation started is not available, do not leave the baseline blank or enter '0'. Use the earliest Reporting Year Sales actual as the Baseline Year Sales. This will cause some underestimation of the total value of incremental sales achieved by the Feed the Future activity, but this is preferable to being unable to calculate incremental sales at all.

If a direct beneficiary sample survey is used to collect incremental sales data, sample **survey estimates must be extrapolated** to total beneficiary estimated values before entry into FTFMS to accurately reflect total sales by the activity's direct beneficiaries.

Note that quantity of sales is part of the calculation for gross margin under indicator *4.5(16,17,18) Gross margins*, and in many cases this will be the same or similar to the value reported here. Please refer to the Feed the Future Agricultural Indicators Guide (http://agrilinks.org/library/feed-the-future-ag-indicators-guide) for additional guidance on collecting and interpreting the data required for this indicator.	
RATIONALE: Value (in US dollars) of purchases from small-holders of targeted commodities is a measure of the competitiveness of those small-holders. This measurement also helps track access to markets and progress toward commercialization by subsistence and semi-subsistence small-holders. Improving markets will contribute to the Key Objective of increased agricultural productivity and production, which in turn will reduce poverty and thus achieve the goal. Lower level indicators help set the stage to allow markets and trade to expand.	
UNIT: *US dollar* *Note: Convert local currency to USD at the average market foreign exchange rate for the reporting year or convert periodically throughout the year if there is rapid devaluation or appreciation.* ***Volume (metric tons)*** *and* ***number of direct beneficiaries*** *covered under the indicator must also be entered into FTFMS.* *FTFMS Note: First enter baseline value of sale (sales in year before Feed the Future efforts) and then enter value of sales in the reporting year in USD. FTFMS* ***will automatically calculate the Value of incremental sales*** *between the baseline year and the reporting year, after adjusting for changes in the number of beneficiaries.*	*DISAGGREGATE BY:* Commodity *Note, Horticultural product-specific disaggregation is not required for the Incremental Sales indicator; the overall "Horticulture" commodity disaggregate can be used if desired. Partners may also choose to report only on sales of the five most important horticultural products, but this is not recommended.*
TYPE: Outcome	*DIRECTION OF CHANGE:* Higher is better
DATA SOURCE: Implementing partner	
MEASUREMENT NOTES: ➢ LEVEL OF COLLECTION: Activity level; those affected by USG activity reach ➢ WHO COLLECTS DATA FOR THIS INDICATOR: Ideally, implementing partner will collect in a census of all target beneficiaries. Sample survey-based approaches are also acceptable. ➢ HOW SHOULD IT BE COLLECTED: The value of incremental sales can be collected directly from a census or sample of farmer beneficiaries, from recorded sales data by farmer's associations, from farm records. ➢ FREQUENCY OF COLLECTION: Annually reported	

Appendix 2. Collecting Data for "Joint" Sex Disaggregate

The following provides an example approach for determining whether the "joint" category is the appropriate Sex disaggregate (i.e., men and women make joint decisions) for situations in which both men and women in the same household are direct beneficiaries of Feed the Future agricultural value-chain activities and it is not clear who should be considered the "farmer" for sex-disaggregation purposes. "Joint" can be used in those cases where men and women ***share*** in decision-making regarding the use of land. ***"Joint" is not applicable to situations in which a male makes the management decisions about the land and a female mainly provides labor.***

For households in which both men and women are direct beneficiaries, you will need to determine who should be considered the farmer of each household plot where a target commodity is grown. All beneficiaries ***should*** be queried regarding decision-making and how to reconcile potential differences in their responses. See the Women's Empowerment in Agriculture Index (WEAI) brochure for questions that could help determine who makes the management decisions for specific plots.

This form is not designed as a stand-alone and would need to be incorporated into your larger data collection forms/format. For example, it includes no identifying information (e.g., name, sex, household ID, village, etc.), or value-chain information. A separate form would be required for each commodity in which both men and women are engaged for gross margin (4.5-16). ***This form is only intended to provide ideas that can be adapted to your context.***

The list below (a-q) is only meant to provide ideas of ***possible*** types of decisions regarding who manages production of the commodity. For example, IPs may only need to know who determines which types of seed to grow rather than who makes decisions regarding different types of seeds (e.g., local, improved, certified). Shaded rows can be deleted if such detail is not warranted. Alternatively, if activities focus on use of certified seed as an improved technology, it may be preferable to know ***only*** who makes decisions specifically about purchasing certified seed.

Production Decisions	X1. When decisions are made regarding the following aspects of production, who normally makes the decision on [Activity]? **CODE 1↓** **If code 6 "Decision not made," skip to next [Activity].**	X2. How much input do you have in making decisions about [Activity]? **CODE 2↓**
a. How many hectares are under production?		
b. What crops to grow?		
c. What type of seed to purchase?		
d. Local		
e. Improved		
f. Certified		
g. When/how to plant?		
h. What inputs to purchase?		
i. What type of fertilizers to purchase?		
j. When/how to apply them?		
k. What type of pesticides to purchase?		
l. When/how to apply them?		
m. What type of herbicides to purchase?		
n. When/how to apply them?		
o. When to harvest?		
p. How the product will be stored?		
q. Other		

CODE 1: X1 Decision making	CODE 2: X2 Input into decision making
Main male or husband 1	No input 1
Main female or wife 2	Input into some decisions 2
Husband and wife jointly 3	Input into most decisions 3
Someone else in the household 4	Input into all decisions 4
Someone outside the household/other 5	
Decision not made 6	

Data Analysis. Each IM should determine how many or which types of decisions qualify as "joint," depending on the project context and mode of implementation. When possible, input should be sought from male and female beneficiaries as to what they feel would be representative of "joint decision-making" with their spouses or heads of household.

Examples of possible ways to code for "joint" for the number of hectares under improved technologies indicator (4.5.2-2):

Perhaps the only circumstance that warrants a classification of "joint" is when the male and female direct beneficiaries share in decisions regarding the purchase of any seed:

- If X1c = "3", then sex = "joint"

Or specifically when they make joint decisions regarding the purchase of improved seed varieties, especially if improved varieties are promoted through the activity:

- If X1e = "3", then sex = "joint"

Alternatively, classification as "joint" may be more appropriate when male and female direct beneficiaries share in a combination of related decisions (e.g., what seed to purchase ***and*** how many hectares of it to plant):

- If X1a = "3", AND X1c = "3", then sex = "joint"

It may also be the case that "joint" decision-making can be defined even when the male direct beneficiary normally makes the decision, but the female direct beneficiary has input into the decision:

- If X1a = "1", AND X2b = "3" OR "4", then sex = "joint"

What constitutes joint decision-making will vary by country or even region. The process and criteria for determining "joint" as the appropriate Sex disaggregate should be well documented for each IM.

Appendix 3. Extrapolating Data

Extrapolation involves two basic steps: (1) calculating an average of what is being measured (e.g., total production, value of sales, number of female farmers applying an improved technology) from a sample of beneficiaries that participated in the activity during the reporting year; and (2) multiplying the average by the total number of relevant beneficiaries to estimate the total value of what is being measured across all activity beneficiaries for the reporting year. ***Each disaggregated data point for each of the indicators must first be extrapolated to the total beneficiary population level prior to entry into FTFMS,*** i.e., figures for each disaggregate category must be individually extrapolated before entry into FTFMS.

For example, data for the five data points required for gross margin are collected from a simple random sample survey of activity beneficiaries using a beneficiary-based sample survey. Assume 300 direct beneficiaries (200 males/100 females) were sampled from a total direct beneficiary population of 30,000 (20,000 males/10,000 females) in a maize value chain project. The total number of hectares planted under maize by male beneficiaries ***in the sample*** is 240, and the total number of hectares planted under maize by female beneficiaries ***in the sample*** is 75. No hectares in the sample were cultivated jointly or by an association/group of farmers. Dividing the total number of hectares cultivated by sampled male beneficiaries by the number of male beneficiaries in the sample (240/200) results in a ***sample average number of hectares cultivated under maize by male beneficiaries of 1.2.*** Dividing the total number of hectares cultivated by sampled female beneficiaries by the number of female beneficiaries in the sample (75/100) results in a ***sample average number of hectares cultivated under maize by female beneficiaries of 0.75***.

Multiplying the average hectares cultivated by sampled male beneficiaries by the total number of male beneficiaries in the activity (1.2 x 20,000) results in an ***extrapolated estimate of the total hectares cultivated under maize by all male beneficiaries of 24,000***, and multiplying the average hectares cultivated by sampled female beneficiaries by the total number of female beneficiaries in the activity (0.75 x 10,000) results in an ***extrapolated estimate of the total hectares cultivated under maize by all female beneficiaries of 7,500***. Since no other Sex disaggregate categories are relevant (e.g., joint), then 24,000 is entered into FTFMS under the maize hectares planted data point for males and 7,500 is entered into FTFMS under the maize hectares planted data point for females.

While an IP should know how many male and female beneficiaries are participating in activities under each value chain during the reporting year, an IP may not know how many beneficiaries fall in the other disaggregate categories required for different indicators (e.g., the type of technology being applied.) IPs should use the sample estimates of the proportion of beneficiaries under each disaggregate category to determine the total number of beneficiaries in each disaggregate category.

For example, the sample survey described above also collected data on application of improved technologies and management practices by the sampled beneficiaries. Of the 300 beneficiaries sampled, 240 (80 percent) applied one or more improved technology. Sixty (20 percent) of the sample applied improved seed (crop genetics), while 210 (70 percent) applied integrated pest management practices. Applying these sample estimates to the total beneficiary population of 30,000 results in an extrapolated estimate of 24,000 beneficiaries applying at least one improved technology or management practice (30,000 x 80 percent). Six thousand beneficiaries applied improved crop genetics (30,000 x 20 percent), while 21,000 applied integrated pest management practices (30,000 x 70 percent.)

Weighted sample averages should be used for extrapolating to the total beneficiary population level. Sample averages should be weighted for sample design and nonresponse.

Appendix 4. Additional Analysis

This section describes additional analysis that ***could*** be undertaken by IPs to enhance interpretation of their program results. However, for some analyses additional data collection would be required.

Gross Margin

Feed the Future requires that the five data points (disaggregated by sex) required for the gross margin indicator (4.5-16) be entered into FTFMS, and encourages IPs to collect additional data of specific relevance to their programs (e.g., amount of water or labor used to calculate gross margin per unit of water or labor).

Measuring gross margin relative to area planted is just one of several ways to evaluate productivity and agricultural returns. Economic theory suggests that returns should be maximized relative to the most limiting resources. Thus, agricultural gross margin is often expressed in terms of the most limiting resource, which varies by country and within countries. For example, farmers in Bangladesh are often most limited by land availability while small-holder farmers in Africa may be most limited by labor. Gross margin per unit of area may be particularly useful when the goal is to intensify production (i.e., produce more on the same or less area) or when land is a limiting factor. In many production systems, water may represent the most limiting factor, in which case analyzing returns per volume of water might be most appropriate. Alternative calculations of gross margin that may be more insightful to certain Feed the Future-supported activities might include:

- Gross margin per unit of labor, and
- Gross margin per farm unit.

Calculating gross margin per unit of labor may be a more relevant measure of expected returns when labor, rather than land, is a limiting factor to productivity. For example, for programs promoting use of mechanized tillage vs. animal-powered tillage would increase gross margin when measured relative to labor, but might not show similar results if measured relative to unit of land. Using labor as the unit of measure requires estimating all labor used. Currently, the gross margin indicator does not require collecting the amount of unpaid labor used or the number of labor days. Thus, calculating gross margin per unit of labor would require collection of addition data, unless you are already collecting this information. For illustrative purposes, a sample tool for recording paid and/or unpaid labor costs is provided in Appendix 9.

An alternative option is to measure gross margin as net revenue accruing to the farmer, or farm operation. This measurement captures entrepreneurial returns related to a farmer's management strategy; some farmers will show more/less profitability than others. For example, increased production, yields, and/or profitability stemming from crop diversification, decisions to increase area planted, etc. might result in higher gross margin when calculated on a farm-level basis.

However, this would require significant additional data collection, which may outweigh the benefits of such analysis.

Finally, gross margin can be compared across farms with similar characteristics and production systems. Thus, gross margins for rain-fed vs. irrigated crops are expected to be structurally different and as a consequence, non-comparable.[81] Depending on how data are collected, when evaluating gross margin for beneficiary populations over time, it may be useful to compare across subgroups to capture these structural differences in farm characteristics. If important structural differences exist in the beneficiary population, IPs should capture such data.

As reported in FTFMS, a total sales figure in USD does not capture differences in price, which occur seasonally, annually, and at point of sale (e.g., farm-gate, local market, institutions, processors). Price increases may affect farmer's gross margins without reflecting changes in overall productivity, value-addition, or improved markets or market information resulting from program interventions. Taking into account the reasons for increased prices can reduce this ambiguity in interpretation of gross margin. Additionally, while an average unit value is implicitly captured by total value and volume of sales, it is extremely sensitive to price extremes. A better representation of unit value at any point in time during the reporting year is the median value of the average unit value, as it is not as influenced by price extremes as the average unit value itself.

To eliminate effects of extreme price values, calculate:

- An average price for each farmer;
- The median value for average price; and
- Value of sales based on the median price.

Incremental Sales

There a number of ways in which custom indicators could be created to make interpretation of results for incremental sales less ambiguous. As noted in the Gross Margin section, taking into account the reasons for price increases would help reduce ambiguity in interpretation of incremental sales, as the total sales figure in USD includes price increases not facilitated by the activity, which affects incremental sales without reflecting changes in overall sales resulting from program interventions. Additionally, a median value of the average unit value is a better measure of price at one point in time during the reporting year than is the average unit value itself (see Gross Margin above).

For some projects, comparing changes in the amount produced with changes in the amount sold might be of relevance. For example, beneficiary farmers may be producing more of a specific commodity but not selling more of it. Assuming no increase in prices, incremental sales of the commodity would not increase even though the more is produced. Alternatively, beneficiary farmers might sell more of the commodity even if they are not producing more of it and incremental sales

[81] For this reason, irrigated and nonirrigated crops are listed as separate commodities in FTFMS.

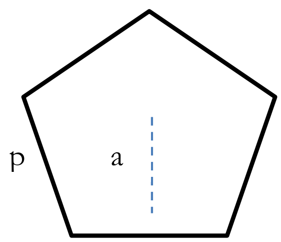
would increase even in the absence of price increases. Thus, incremental changes in production can be compared with incremental changes in the amount sold to help interpret changes (or lack thereof) in incremental sales as well as gross margin. Ideally, both production and sales volume would be increasing.

Number of Farmers and Others Applying Improved Technology or Management Practices

Farmers and others mix and match technologies and management practices to suit their circumstances, layering and innovating to create production systems best suited to their needs and available resources. A qualitative component can add richness to interpretation of observed results and better understanding of farmer's behavior as it relates to the uptake of improved technologies or practices. Qualitative analysis can assess: a) reasons for uptake; b) reasons uptake did not occur; c) intent to continue use; and d) assessment of impact on production.

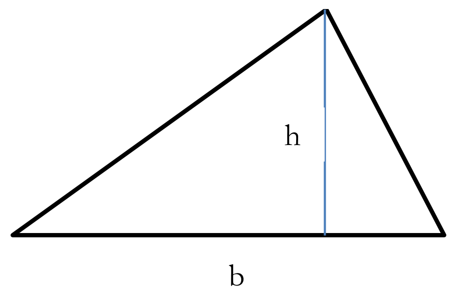
Appendix 5. Formulas for Area

Regular polygon



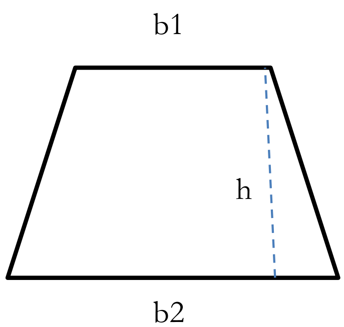
A = ½ apothem X perimeter

Triangle



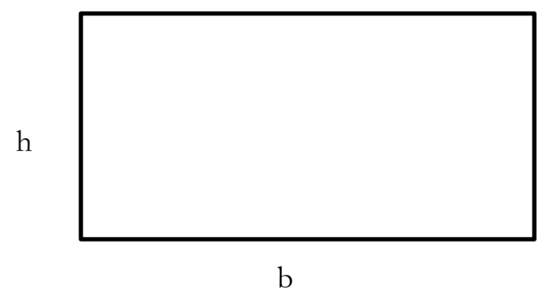
A = ½ base X height

Trapezoid



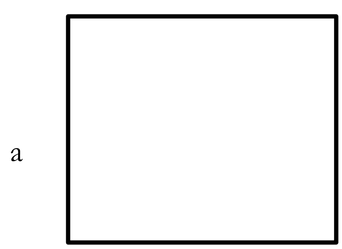
A = h X (a + b/2)

Rectangle



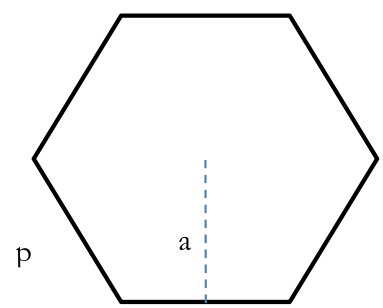
A = base X height

Square

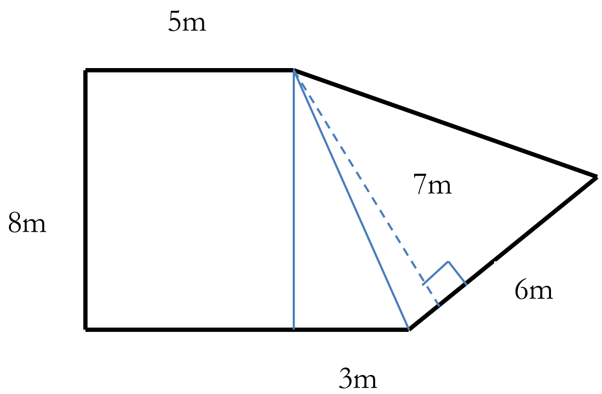


$A = a^2$

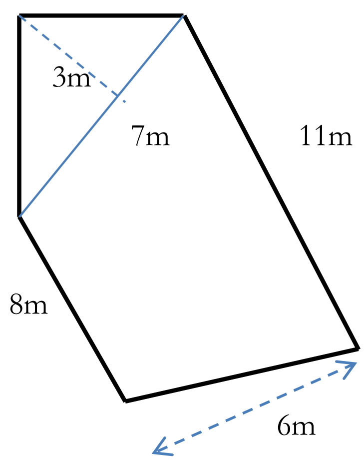
Regular polygon



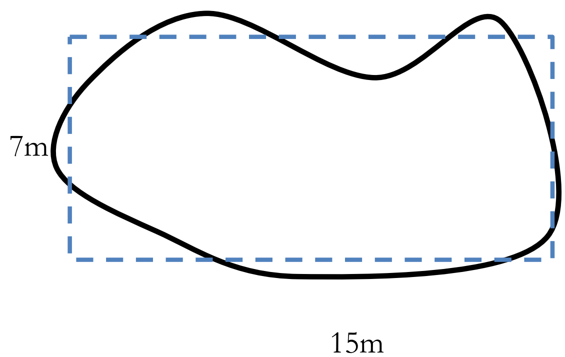
A = ½ apothem X perimeter



A = (8 X 5) + ½ (3 X 8) + ½ (7 X 6) = 73m^2



A = ½(3 X 7) + 6(8+11/2) = 67.5m^2



A = 7 X 15 = 105m^2

For additional information on and programs for calculating area of irregular polygons:

http://www.mathopenref.com/
http://www.mathsisfun.com/area.html
http://www.spectrumanalytic.com/support/library/ff/area_calculations.htm
http://www.onlineconversion.com/shape_area.htm

Appendix 6. Collecting Data on Cash Input Costs

The table below provides an illustrative example of recording production costs for the gross margin indicator (4.5-16). The categories of input costs listed here are for crops and should be modified to fit your project activities (e.g., livestock, fisheries) and reporting needs (i.e., expanded, rolled up). Appendix 9 provides an illustrative example of recording labor costs.

Farmers often report only a single total for recurring input costs, in which case the data collection form would ***not*** require information pertaining to quantity, units, or unit costs and Columns B-D could be deleted. Rather, only the type of cost and the total amount the farmer paid for it would be required.

This form is not designed as a stand-alone and would need to be incorporated into your larger data collection forms/format. For example, it includes no identifying information (e.g., name, household ID, village, sex, etc.), or value-chain information. A separate form would be required for each commodity. ***This form is only intended to provide ideas that can be adapted to your context.***

The types of input costs should be modified to fit your project. The list below is only meant to provide ideas of ***possible*** types of cash input costs a farmer might incur for crops (a completely different set of input costs would be needed for livestock or fisheries products). For example, your project may only need to know how much the farmer paid for seed generally, rather than the costs per different types of seed (e.g., local, improved, certified). Shaded rows can be deleted if such detail is not warranted. Alternatively, if your program focuses on use of certified seed as an improved technology, you may prefer to know how much is spent for each type of seed purchased, as you would expect to see increasing purchases of certified seed over other seed types over the life of the activity.

If multiple purchases of a specific input are made, or purchases of an input in which the units differ (e.g., fertilizer in 50 kilogram bags and liquid fertilizer in a 1 gallon bottle), each transaction should be recorded separately. Rows can be added as needed for individual transactions.

- Costs must be converted to USD before entry into FTFMS.

A	B	C	D	E
Category	Quantity	Units	Unit Cost (local currency)	Total
Land Lease/Rental				
Fees (e.g., water users)				
Seed				
Local				
Improved				
Certified				
Fertilizers				
Organic				
Inorganic				
Manure				
Pesticides				
Organic				
Inorganic				
Type…				
Herbicides				
Organic				
Inorganic				
Type….				
Materials				
Processing				
Bagging				
Storage				
Warehouse fees				
Storage bags				
Transport				
Other				
Total				

Appendix 7. Collecting Data on Labor Costs

The following provides an illustrative example of recording costs associated with labor, both paid and unpaid. Types of labor costs should be modified to fit your project activities. Although this particular form allows for collecting data on unpaid labor costs (which is important for some IMs), ***costs for unpaid labor should not be included in reporting under gross margin (4.5-16) in the FTFMS.***

- If excluding unpaid labor costs, delete Column B.
- Columns B and C will total Column D.
- For reporting total paid labor in FTFMS (Column F), multiply Column C by Column E.
- Column G represents the value of all labor (paid and unpaid).

Farmers often report only a single total for labor costs, in which case the data collection form would ***not*** require information pertaining to number of person-days, unit costs, etc. and Columns B-F could be deleted. Rather, only the type of labor cost and the total amount the farmer paid for it would be required.

This form is not designed as a stand-alone and would need to be incorporated into your larger data collection forms/format. For example, it includes no identifying information (e.g., name, household ID, village, sex, etc.), or value-chain information. A separate form would be required for each commodity. ***This form is only intended to provide ideas that can be adapted to your context.***

The types of labor tasks should be modified to fit your project. The list below is only meant to provide ideas of ***possible*** labor needs a farmer might require for crops (a completely different set of labor costs would be needed for livestock or fisheries products). For example, your project may only need to know how much the farmer paid for all pesticide applications generally, rather than the costs of each pesticide application. Shaded rows can be deleted if such detail is not warranted. Rows can be added to track labor costs each time an activity occurs, or when the unit costs differ for the same activity.

- Costs must be converted to USD before entry into FTFMS.
- Three people working for 4 days is 12 person-days
- Three people working for 4 days is 12 person-days PLUS two people working for 6 days is 12 person-days for a total of 24 person-days.

NOTE: Unpaid labor could be family or communal. **Do not include labor provided by the household to other farms.**

A	B	C	D	E	F	G
Labor	Unpaid person-days*	Paid person-days	Total number of person-days	Unit cost (local currency)	Total paid labor costs	Total labor costs
Nursery Management						
Land Clearing						
Land Preparation (plowing, harrowing)						
Hand						
Animal						
Mechanized						
Transplanting						
Seed broadcasting						
Clearing irrigation channels						
Installing drip						
Fertilization						
1st application						
2nd application						
Pesticide Application						
1st application						
2nd application						
Weed Control						
Thinning						
1st weeding						
2nd weeding						
Bird scaring						
Harvest						
Cutting/harvesting						
Collecting and bundling						
Shelling/threshing						
Winnowing						
Other Cultural Practices						
Other						
Total						

* A person-day is the number of people working times the number of days worked.