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A Strategy for Agricultural Statistics in Ghana

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THE GHANA STRATEGY SUPPORT PROGRAM (GSSP)

WORKING PAPERS

ABOUT GSSP

IFPRI's Ghana Strategy Support Program (GSSP) was launched in 2005 to address specific knowledge gaps concerning agricultural and rural development strategy implementation, to improve the data and knowledge base for applied policy analysis, and to strengthen the national capacity for practical applied policy research. The primary objective of the Ghana Strategy Support Program is to build the capabilities of researchers, administrators, policymakers, and members of civil society in Ghana to develop and implement agricultural and rural development strategies. Through collaborative research, communication, and capacity-strengthening activities and with core funding from the U.S. Agency for International Development/Ghana (USAID), GSSP works with its stakeholders to generate information, improve dialogue, and sharpen decisionmaking processes around the formulation and implementation of development strategies.

ABOUT THESE WORKING PAPERS

The Ghana Strategy Support Program (GSSP) Working Papers contain preliminary material and research results from IFPRI and/or its partners in Ghana and have not been peer reviewed. They are circulated in order to stimulate discussion and critical comment. The opinions are those of the authors and do not necessarily reflect those of their home institutions or supporting organizations.

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Acronyms

ASC	Agricultural Sample Census
CAADP	Comprehensive African Agricultural Development Program
CAFE	Computer Assisted Field Edits
DADU	District Agricultural Development Unit
EA	Enumeration Area
GAPS	Ghana Agricultural Production Survey
GLSS	Ghana Living Standards Survey
GLSS+	Ghana Living Standards Survey +
GPRS-II	Growth and Poverty Reduction Strategy II
GPS	Global Positioning System
GSS	Ghana Statistical Service
GSSP	Ghana Strategy Support Program (IFPRI)
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation Agency)
IFPRI	International Food Policy Research Institute
ISCO-08	International Standard Classification of Occupations, International Labor Organization
ISSER	Institute for Statistical, Social and Economic Research, University of Ghana
MCA	Millennium Challenge Account
MCC	Millennium Challenge Corporation
MEA	Monitoring and Evaluation Assistant
MET	Monitoring and Evaluation Team
METL	Monitoring and Evaluation Team Leader
MiDA	Millennium Development Authority
MoFA	Ministry of Food and Agriculture
MRACLS	Multi-Round Annual Crop and Livestock Survey
SRID	Statistical Research and Information Division (MoFA)
WHO	World Health Organization

Table of Contents

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Introduction

Agriculture is the backbone of the Ghanaian economy. It plays an important role in the socioeconomic development of Ghana as it contributes to ensuring food security, provides raw materials for local industries, generates foreign exchange, and provides employment and incomes for most of the population (especially those living in the rural areas), thereby contributing to economic development and poverty reduction.

The central goal of Ghana's current development strategy, which is detailed in the Poverty Reduction Strategy II (GPRS-II), is to accelerate economic growth in order to achieve middle-income status within a measurable planning period. Subsequently, the government has placed a focus on implementing agricultural policies to bring more land under cultivation in order to generate a rapid supply response that will quickly benefit the poor in rural areas.[1] These interventions are also intended to help develop a private agricultural sector that contributes to accelerated and sustained growth in the long run.

Monitoring and evaluating the progress of these initiatives requires quality agricultural data for large-scale and household-based production that is collected frequently (in order to address the dynamics of agricultural production) on a spatially disaggregated level. This suggests the need for a system that regularly produces precise agricultural statistics on an annual basis at the district level. This is an important consideration because numerous interventions are currently implemented at that administrative level and many more will be operationalized at the district level in the future as Ghana continues to decentralize. However, recent data gathering activities by the Ghana Statistical Service (GSS) and the Statistics, Research, and Information Directorate (SRID) of the Ministry of Food and Agriculture (MoFA) do not currently meet these requirements. Future agricultural surveys must address this gap in order to support the government's interventions and planning processes and, in turn, maximize the effectiveness of agricultural growth and poverty reduction efforts.

The objective of this report is to provide (1) a brief synopsis of the reasons why the current agricultural statistics system is inadequate, which provides justification for the development of a revamped agricultural statistics system, and (2) a concrete strategy for moving forward. In particular, the aim of this report is to operationalize a process to enhance Ghana's agricultural statistics system to the point where it can regularly (annually) provide higher quality (precisely measured), disaggregated (district level) data for broader and deeper analysis of agricultural topics (greater crop, livestock, forestry, and aquaculture coverage) in order to facilitate improved, evidence based monitoring, planning, and research at the central and local administrative levels.

This report is organized accordingly: Section 2 reviews the existing agricultural statistics system and Section 3 discusses the role of the Ghana Living Standards Survey (GLSS). Section 4 proposes a general strategy to improve Ghana's agricultural statistics system and Section 5 recommends the most practical option for implementing this approach. Finally, Section 6 details a calendar of events for operationalizing this strategy. Additionally, supporting information can be found in the Appendix and the Technical Addendum.

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[1] See Muñoz (2010) for details about these proposed policy areas.

Review of the existing agricultural statistics system

The two most relevant agricultural data collection activities undertaken by GSS and MoFA are:[2]

- Agricultural Sample Census (ASC): Under the authority of GSS, an ASC is planned along with a Population and Housing Census, approximately every 10 years. However, the last time this took place was in 1984, over a quarter of a century ago.
- Multi-Round Annual Crop and Livestock Survey (MRACLS): Under the direction of MoFA, agricultural data is collected annually at the district level. MRACLS questionnaires are intended to produce agricultural data from a sample of household, commercial, and institutional farms in every district related to small scale farming practices, inputs, infrastructure, labor utilization, assets, sales, livestock and poultry, field measurements, and yield estimates. However, the bulk of the MRACLS survey questionnaire (Forms 2 and 5) has not been fielded in recent years and, as a result, this activity only generates data for holders based on field measurements and yield estimates in practice. In other words, the MRACLS does not provide detailed information from holders concerning farming practices, inputs, infrastructure, labor utilization, assets, sales, as well as livestock and poultry, and so forth, or any information regarding commercial and institutional farms, as originally intended. Moreover, MoFA does not make raw data available, but rather, only shares the aggregated statistics via SRID.

Given that the ASC has not been fielded in 26 years, the weight of meeting Ghana's agricultural data requirements has fallen on the MRACLS. During this period the MRACLS has continued to function; however, the scope of its operations has declined considerably over the years due to a number of constraining factors that have critically weakened the quality and breadth of the data it produces. In particular, Nyanteng and Aggrey-Fynn (2009) point out that insufficient funding and staff, as well as inadequate logistics, have led to the following MRACLS shortcomings:

- Data are collected in districts, but the coverage is less than complete. The MRACLS has yet to be operationalized (staffed, equipped, and implemented) in 38 recently established districts (new administrative areas that have split from the original 138 districts).
- The bulk of the survey (forms 2 and 5) are currently not administered due to resource constraints. The original MRACLS questionnaire consisted of the following 5 forms: (1) household and holders listing, (2) holding enquiry, (3) field area measurement, (4) crop yield measurement, as well as (5) commercial and institutional enquiry. That being said, only the shortest forms (1, 3, and 4) are currently fielded in order to minimize costs.
- No data is collected for the minor season, although it is needed in the South.
- Questionnaire and field measurement sample size has been reduced from 20 holders per enumeration area (EA) to 10.

[2] See Muñoz (2010) and Nyanteng and Aggrey-Fynn (2009) for a more comprehensive and thorough review of agricultural data collection activities.

- Yield estimate (crop cutting) sample size has been reduced from 20 holders per EA to 5.
- Statistics are only disseminated in aggregate, rather than in raw data format. Although raw data is collected, it is processed for MoFA's purposes before being shared. This makes it unsuitable for addressing many stakeholders' monitoring, evaluation, analysis, or planning needs and restricts assessment of the data quality.

As a result, MRACLS operations currently provide imprecisely measured statistics for a small, unrepresentative sample.

The following are the chief weaknesses that have decreased institutional capacity and prohibited the MRACLS from providing comprehensive, precise measurements and meeting its objectives:[3]

- Human resources: inadequate number of dedicated and trained individuals committed to agricultural surveying tasks. Staff involved in fielding the MRACLS are primarily responsible for extension activities and only undertake surveying activities as secondary roles. Combining these two roles is problematic not only because it reduces the time available for surveying activities, but also most importantly because it can skew the data being produced in the following ways: (1) holders being interviewed by extension officers may receive more information or guidance than holders in other EAs that are not included in the survey (and therefore receive fewer visits), making them unrepresentative of holders in the district and (2) extension officers are not impartial individuals in the agricultural production process, thus their participation in agricultural data collection may bias responses.
- Implementation resources: insufficient funds for travel and logistical support. Given the limited resources for these integral activities, data collection activities receive minimal priority in de-centralized district offices.
- Equipment: the supplies needed to adequately perform surveying tasks are not available to staff (from basic requirements such as pencils, measuring tape, and calculators to more technologically advanced materials such as handheld GPS devices and computers).
- Data management and quality control: inadequate procedures and software devoted to inputting, processing, and disseminating high quality data.

In addition, a review of the ACS and MRACLS demonstrates that they share many similarities in both the design of their methodologies and field instruments (excluding the dimension of time and frequency). This suggests that unless the ACS was fully funded and well managed it too would be plagued by the same institutional challenges that have undermined the MRACLS. Consequently, it is imperative that the parallel institutional problems constraining the ACS and MRACLS be addressed to ensure the success of future agricultural data gathering activities.

[3] See Nyanteng and Aggrey-Fynn (2009) for a more thorough discussion of these constraining factors, amongst others.

Moreover, it should be pointed out that the comparable way in which their questionnaires have been designed to provide data addressing similar topics suggests that one well funded, designed, and implemented agricultural survey would be sufficient to meet the needs of national and local policy makers, planners, and researchers, if it were to be fielded annually. In other words, if the MRACLS were functioning as intended, there would be no need for a decennial ACS because Ghana would already, in effect, have an annual agricultural sample census.

Even if the MRACLS were implemented as designed, the following dimensions would still merit special attention in order to ensure that the agricultural statistics system meets the needs of stakeholders:

- Sample size and district level representativeness: the MRACLS sampling strategies were initially well conceived to provide rough statistics for districts. The original sample design called for data collection from 20 holders in 10 EAs in each district, which is equivalent to 200 observations per district (totalling 27,600 observations). However, as said before, procedures have been modified in a way that reduced sample size levels to the point where only 10 holders were surveyed in 10 EAs in each district, which is equivalent to 100 observations for each district (totalling 13,800 observations). A sample of this size is insufficient to provide precise district level statistics. Ideally, a sample of about 400 holders should be visited in each district (all 176 of them) resulting in a total of 70,400 observations. This sample will provide district estimates with a margin of error of 5 percentage points for key indicators, such as the percent of farmers growing a given crop or using an input.
- Precision of measurements and data management: incorporation of recent technological advances such as the use of GPSs for plot measurement and location. Implementation of a system of computer assisted field edits (CAFE) for collected data, which provides an opportunity to identify and correct errors while still in the field.
- Dissemination of raw household data, as opposed to aggregated statistics: although this has already been discussed above, it merits an additional mention because it is essential to the success of an agricultural statistics system. Sharing raw data will enable all stakeholders to better understand agriculture in Ghana and to evaluate the quality of the data. Conversely, restricting data sharing to aggregated statistics limits the value, applicability, and credibility of any collected information.
- District level feedback loop: timely generation of indicators and descriptive statistics directly useful for policymaking and monitoring at the district level. This is essential in order to motivate a greater appreciation and use of the data that is collected, which will incentivise future production of high quality data.

Fielding the entire questionnaire as originally designed would significantly improve the breadth and depth of the data the MRACLS provides. That being said, there are still a number of ways that it could be improved to better serve stakeholders interested in monitoring, evaluation, and research. The following list is an example of some key improvements that should be made, although this does not constitute an exhaustive set

of recommendations.[4] Making these revisions would allow stakeholders to obtain a more comprehensive and deeper understanding of the agricultural situation in Ghana. In particular, it would facilitate more direct and clear assessment of how a variety of factors influence agricultural processes, such as asset ownership, crop choice, input use, access to information, marketing, and production, among others. The questionnaire should include modules on:

- Tenure and land use patterns: Access to land, tenure (community owned, household, individual customary or individual statutory, rented, sharecropped, squatted, shared, etc.), and use (cultivated or fallow).
- Plot or farm-wise information on input use: labor including wages, seeds, organic and inorganic fertilizer, pesticides and herbicides, equipment use and ownership, as well as credit sources, uses, and terms.
- Plot or farm-wise information on output: quantity and price of sold consumed and stored production, as well as location of sale for an expanded list of crops field crops, trees, livestock, horticulture, and aquaculture.
- Post harvest storage.
- Processed agricultural goods, such as honey, milk, milled grains, canned produce, etc.
- Shocks that affect agricultural productivity.
- Demographic information: Nationality, ethnicity, language, and literacy, and detailed education information, which is a key measure of human capital. As well as rigorously coded primary and secondary occupation information (using the International Labor Organization's International Standard Classification of Occupations – ISCO-08).
- Household asset ownership and dwelling information, which serve as reliable proxies for welfare.

In addition, special attention needs to be paid to the issue of measuring the role of women in Ghanaian agriculture. Careful consideration of their agricultural responsibilities and how to best measure the underlying factors and implications of their participation is needed in order to ensure the issue of gender is adequately assessed.

[4] Also, see Ngeleza and Asante (2010) for a more thorough discussion and details of potential changes.

Complementary role of the Ghana Living Standards Survey (GLSS)

The GSS also fields a multi-topic household survey, the Ghana Living Standards Survey, which is primarily focused on providing a number of socioeconomic indicators. In particular, it is designed to produce measures related to consumption and poverty assessment. It has been fielded every 5 to 6 years since 1987 (the most recent GLSS was fielded in 2005 and the next is planned for 2011). GLSS questionnaires also provide some agricultural information at the household level concerning assets (i.e., land and livestock), crop harvests, sales and purchase prices, income and expenses (including inputs), as well as own-consumption.[5] In the absence of a fully functioning agricultural statistics system, stakeholders have drawn on GLSS data to address a diverse and expanding set of agricultural issues. However, the GLSS data is not as well suited to addressing agricultural issues, which are dynamic and require particularly detailed, disaggregated, and regularly/frequently generated data, because:

- The interval between rounds is too large for monitoring and evaluation.
- Representativeness at the regional level is inadequate for districts.
- The instruments and methods of measurement are not tailored for agriculture because they are intended for poverty assessment, which is done strictly at the household level (instead of holder, farm, or plot), and households are visited only once in the year, irrespective of seasonality.

The strength of the GLSS survey lies in its ability to assess living standards in terms of consumption, asset ownership, and income, amongst others, as well as in relation to each other. Consequently, the agricultural data that the GLSS provides is also extremely useful for assessing the relationship between agriculture and other sectors, such as poverty, education, health, and labor. It provides a strong resource for researchers, but not readily accessible information for monitoring, evaluation, and planning at a disaggregated level. Although it is not well suited to providing regular, disaggregated, precisely measured agricultural data, it is well positioned to complement a strong agricultural statistics system by facilitating these additional dimensions of analysis. That being said, the single most important manner in which the GLSS can improve its agricultural contribution is via the refinement of its instrument (questionnaire) and methods of measurement to better suit the agricultural sector. The following are a few of the key areas to improve:

- Diversity of units used in measuring production and the lack of clarity in conversion factors.
- Additional information concerning field crops, tree crops, horticulture, livestock, and aquaculture, as well as detailed input and output data by plots when relevant.
- Precise plot area measurements and geo-referencing.

Building on the GSS's recent GLSS5, the Ghana Living Standards Survey + (GLSS+) addresses some of these shortcomings as part of a data gathering effort intended to facilitate impact evaluation of interventions by the Millennium Development Authority (MiDA) – the Ghanaian government entity responsible for implementing the Millennium

[5] See Muñoz (2010) and Nyanteng and Aggrey-Fynn (2009) for a more comprehensive and thorough review of the GLSS.

Challenge Account (MCA) compact and Millennium Challenge Corporation (MCC) activities. The survey was initiated in 2008 and is an ongoing effort currently being implemented by the University of Ghana's Institute of Statistical Economic Research (ISSER), GSS, and MiDA. The GLSS+ consists of panel data for a total sample of 9,300 randomly selected households in 23 districts where MiDA interventions are ongoing (a baseline with follow up rounds over time).

Although the GLSS and the GLSS+ are conducted on independent samples, their instruments and methods are similar. The GLSS+ collects data on a broad set of topics much like the GLSS, including agriculture and consumption, that are relevant to monitoring and evaluating MiDA projects, as well as conducting medium to long-term research. However, given that the GLSS+ is limited to districts with ongoing MiDA interventions it may be biased; for instance these districts may be poorer, on average, and consequently not be nationally representative. As such, the survey is not designed to meet the needs of national or district level stakeholders.

A proposed strategy

In order to meet the agricultural statistics needs of planners and researchers in Ghana, we propose simultaneously (1) assisting MoFA in strengthening its implementation of MRACLS, and (2) working with GSS on improving the agricultural module of the GLSS instrument. To assist MoFA in implementing the MRACLS following best practices, we propose piloting an improved version of the current MRACLS entitled the Ghana Agricultural Production Survey 2011 (GAPS), which will be described in further detail in the next section.

The GAPS intends to pilot the following key improvements to be made in the MRACLS in order to strengthen Ghana's agricultural statistics system:

- Disaggregated and updated sample design (district representativeness)
- Expanded scope and depth of (georeferenced) agricultural information collected[6]
- New and enhanced management system consisting of improved data management practices and tailored software for improved and timely data processing, monitoring, and reporting

In the process of addressing these issues, the GAPS will provide (1) nationally representative agricultural data of improved quality in the short-run from a selection of districts (detailed in the next section), (2) provide expertise for improving MRACLS data collection in the future, (3) offer guidance for scaling up to collect high quality, (nationally representative) data in all districts in the long-run, and (4) also serve as a pilot to the next ACS, if its implementation is delayed.

[6] See Ngeleza and Asante (2010) for a more thorough discussion and details of some proposed changes, as well as additional background information.

Implementing the 2011 Ghana Agricultural Production Survey (GAPS)

The implementation of GAPS is proposed as a way (1) to pilot improvements needed in the MRACLS in order for it to overcome recent deficiencies and provide statistics of greater quality, breadth, depth, and representativeness, required by stakeholders, and (2) to examine the resource, methodology, sampling, panel, instrument, and management implications of scaling up these improvements to all the districts. The GAPS aims to conduct a small, but well funded and strongly supported agricultural production survey in 2011 by building on and improving the existing methods and tools of the MRACLS. Besides providing a high quality dataset that can be used immediately, the GAPS would serve as (1) a springboard for the fielding of an 'Enhanced MRACLS' in 2012 and beyond, (2) an opportunity to investigate the feasibility of surveying a panel of holders over time, as well as (3) a pilot exercise for the ACS.

The GAPS would be supported with funding and technical assistance by IFPRI, which would effectively serve to address the resource constraints that have crippled the effectiveness of the MRACLS. The GAPS would be implemented by MoFA with specialized agricultural consultation and collaboration from GSS. The proposal is to field the GAPS from February 2011 through January of 2012 for four reasons:

- Provide sufficient time to prepare the survey
- Cover both major and minor seasons from start to finish
- Disseminate data in a timely fashion
- Provide feedback that will be implemented to refine a national, full scale agricultural production survey, such as an 'Enhanced MRACLS', in 2012.[7]

Sampling: The GAPS would be fielded in 2 districts in each region of Ghana, producing data for a total of 20 districts. In each district, the sample would consist of roughly 400 holders chosen in two stages beginning with selection of 40 Census Enumeration Areas (EAs) and followed by the selection of 10 holders in each of the chosen EAs. In addition, all commercial and institutional farms will be visited. This effort would provide a total sample of 8,000 holder observations, sufficient to provide well measured and reliable national statistics, as well as rough regional measures.[8] District level estimates would only be available for the selected districts, but within each of them, the estimates would be of the precision and quality expected from the upcoming census and 'Enhanced MRACLS'. Such improved data would support effective, national, and decentralized evidence-based agricultural planning and analysis.

Panel: Policymakers' and researchers' abilities to assess the effectiveness of interventions over time and investigate medium to long-term agricultural dynamics would be considerably enhanced, if a panel component were to be included in the sampling design of future MRACLSs. As such, the GAPS sample design plans include observation

[7] See the next section for a more detailed schedule of events for GAPS.

[8] The national and regional indicators produced by the proposed three-stage sampling design (with districts in the first stage, EAs in the second stage, and households in the third stage) will be larger than what could be obtained with a simpler two-stage design (with EAs in the first stage and households in the second stage) but the selection of districts is imposed by the experimental nature of the GAPS. Thus, the survey should follow the same operational procedures that the ASC and the MRCLS will adopt later to address district level data needs.

of some of the same households over time from the outset. Although panel data collection is harder to manage because attrition (the survey's inability to re-contact some household in successive years) needs to be minimized, the benefits of addressing these issues in order to facilitate agricultural analysis and impact assessment over time greatly outweigh the costs. Consequently, GAPS will develop procedures and protocols to identify and facilitate access to a panel of holders in the future.

Instruments: a thorough review of MRACLS instruments (questionnaires, crop cutting techniques, and so forth) is proposed in order to develop one set of improved instruments that would be piloted. In particular, a review of MRACLS questionnaires should keep in mind whether the instruments are adequate to meet the monitoring requirements of the Comprehensive African Agricultural Development Program (CAADP), the planning needs of Ghana (at central and district levels), as well as the research needs of scientists. IFPRI is willing to facilitate an immediate review of the questionnaire and to field-test the revisions so that the survey can begin in February 2011 as planned (see proposed calendar of events in Section 6). After discussion and once agreement with stakeholders is reached, these will be reformatted to improve the effectiveness and efficiency of the interview experience for enumerators and holders.

Management: Training of all staff would take place in January of 2011 and be supplemented by team based supervision throughout the entire survey process. In combination, these efforts would address issues relating to the relevance of questions and concepts, interviewing skills, and data quality. Another important component of the proposed GAPS would be the enhancement of survey and data management practices. GAPS would be coordinated by MoFA under the guidance of one IFPRI project coordinator (ensuring a centralized logistics and data management system), along with the consultation of GSS. Improved data management would be accomplished by the introduction of custom designed data management software and by relying on computer assisted field edits (CAFE). All data generated in the field would be transmitted in raw form (not processed or aggregated, which is currently the case) to the project coordinator and a designated counterpart in MoFA on a weekly basis. This system would serve to identify inconsistencies when they can still be addressed by staff in the field, to ensure consistent and centralized data management, as well as to expediently provide basic (national to district level) statistics for the purposes of monitoring and planning. These components of the GAPS would address issues related to the quality, consistency, and format of data needed to facilitate effective agricultural monitoring, planning, and analysis.

Undertaking this process would enable MoFA not only to drastically improve Ghana's agricultural statistics system, but also to considerably better its tools, methodologies, and practices. Meanwhile it would also make it possible for MoFA and GSS to assess the best way forward, which would include a national scaling up of the GAPS in the form of an 'Enhanced MRACLS.' In such a case, Ghanaian planners and researchers would have access to high quality and comprehensive agricultural data on an annual basis, essentially eliminating the need for a periodic AGC in the future.

For additional details on the proposed strategy and how to implement the GAPS, please see the Technical Addendum.

GAPS calendar of events

The design and implementation of the GAPS, followed by the application of the acquired experiences to the Agriculture Sample Census and an 'Enhanced MRACLS' will require carefully coordinating the activities of many persons and institutions for the next three years. The timeline of events presented in the next pages, which was initially proposed in May of 2010 and will be continually revised, should be of help in this process.

Activities in the calendar, which are presented at the end of this section, are sorted into task groups.

The first group shows the major data collection activities in perspective, with the 2011 GAPS fielded from mid-March 2011 till March 2012 and the ASC starting in February 2012 (rather than in late 2011 as had once been suggested). The 2010 Population Census and the next round of the GLSS are shown for reference, even though they are not operationally linked to the GAPS. Although the GSS has not yet announced the GLSS-6 launching, it should ideally be postponed till late 2011, to have the design of this survey benefit from the experiences gathered by the GAPS.

The next group shows the detailed calendar of data collection activities in the southern agro-ecologic regions. The calendar for the northern regions will be similar (but not identical) in the first part of the year, and quite different in the second part, due to the differences in their respective patterns of cropping seasons (two seasons in the south and one in the north).[9]

The third task group shows activities related to the project's management, financing, and logistics. The two most critical and urgent activities in this group are the hiring of the GAPS coordinator and the establishment of institutional agreements between MOFA and IFPRI.

The fourth task group is the development of the GAPS questionnaire and methods. The revision process has already started and it will be divided into two parts. The first part will focus on the questionnaires that will be applied in the major season. The major landmark is a field test during the week of November 29, followed by the preparation of the associated documents (field manuals, training materials, etc.) The questionnaires for the minor season will be developed in parallel, but with a later deadline (May 2011).

A mid-term assessment of all procedures and tools will take place in September, with the intention of making informed recommendations for the eventual scaling up of the effort in 2012.

The fifth task group shows sampling-related activities. The 20 GAPS districts should be selected as soon as possible, to launch some of the reconnaissance activities specified in the next task group.

The sixth task group shows the activities related to the training of the GAPS fieldworkers (Monitoring and Evaluation Team Leaders and Assistants – METLs and MEAs, respectively). The GAPS will need 100 fieldworkers in total (5 per district) and they will be trained centrally on two occasions: in early March 2011, for the major season tools,

[9] The timeline units are weeks. The scale is not uniform, to show with better detail the most immediate tasks. Weeks start on Monday. The numbers on top represent the first Monday of each month.

and in early September, for the minor season tools. Training will be conducted by a small group of Master Trainers, who will need to be identified early enough for them to participate in the November field test and to develop the training materials on the basis of that experience.

One year later, the ASC will be able to use all of the manuals, training methods, and materials developed by the GAPS, but it will need to decentralize the process, because of its much larger size. Additionally, it will require the prior training of a much larger group of competent master trainers.

The last task group shows the activities related to data management. The GAPS will implement computer assisted field edits (the CAFE approach), which has proven its advantages in many similar surveys in other countries.

Under this strategy, data entry and consistency controls are applied on a household-by-household basis as a part of field operations, so that errors and inconsistencies are solved by means of eventual re-visits to the households or holdings.

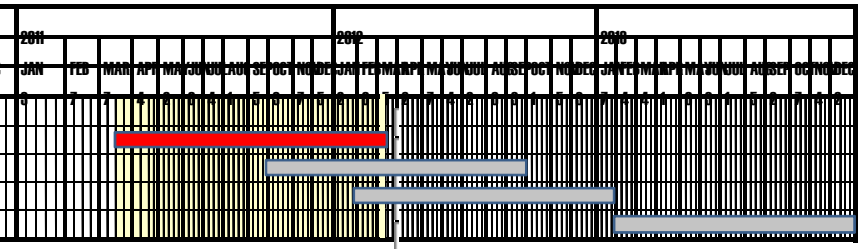
The most important and direct benefit of integration is that it significantly improves the quality of the information, because it permits correcting errors and inconsistencies while the MEAs are still in the field rather than by office “cleansing” later. Besides being lengthy and time-consuming, office cleansing processes at best produce databases that are internally consistent but do not necessarily reflect the realities observed in the field. The uncertainty stems from the myriad of decisions, which are generally undocumented, that need to be made far from where the data are collected, and long after the data collection.

The integration of computer-based quality controls can also generate databases that are ready for tabulation and analysis in a timely fashion, generally just a few weeks after the end of field operations. In fact, the GAPS intends to develop its databases as the survey is conducted, thus giving SRID’s core staff the ability to effectively monitor fieldwork.

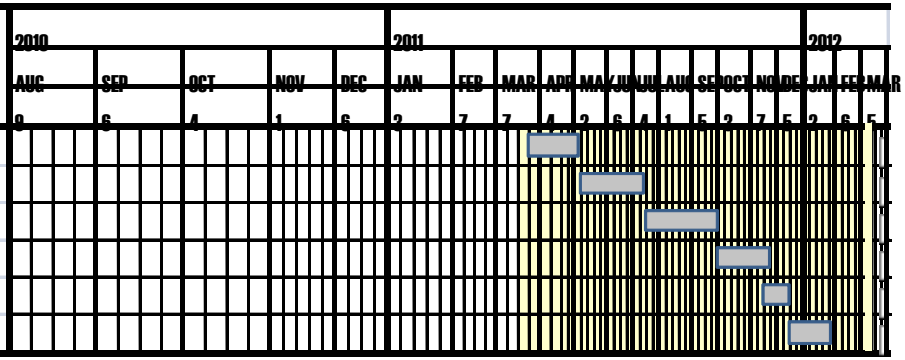
Another indirect advantage of integration is that it fosters the application of uniform criteria by all the MEAs and throughout the whole agricultural year, which is hard to achieve in practice otherwise. The computer can indeed become an incorruptible and tireless assistant of the METL.

It should be emphasized that the GAPS will not try to eliminate paper questionnaires. The integration of computer-based quality controls to fieldwork can be implemented without doing this.

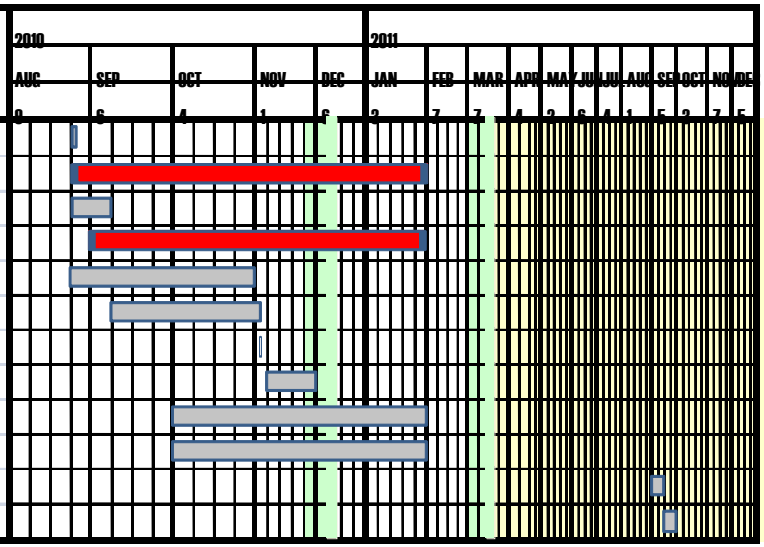
1	Major data collection efforts			Responsible
1.01	2010 Population Census	4 Oct 10	31 Oct 10	GSS
1.02	2011 Ghana Agriculture Production Survey (GAPS)	21-Mar-11	18-Mar-12	MoFA, IFPRI
1.03	Ghana Living Standards Survey VI (GLSS-6)	1-Oct-11	30-Sep-12	GSS
1.04	2012 Agriculture Sample Census	1-Feb-12	31-Jan-13	GSS
1.05	2013 Enhanced MPCLS	1-Feb-13	31-Jan-14	MoFA



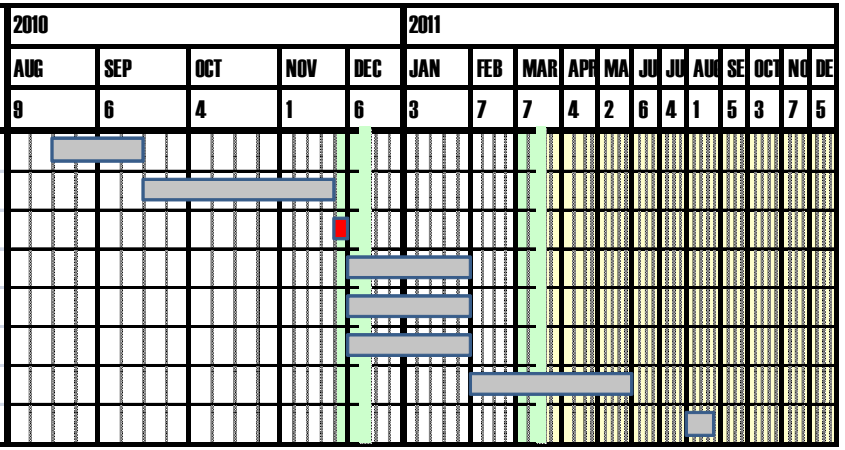
2	Detailed calendar of the GAPS in the southern regions			Responsible
2.01	Publicity and household listing	28-Mar-11	6-May-11	MoFA, IFPRI
2.02	Area measurement and interviews (major season)	9-May-11	15-Jul-11	MoFA, IFPRI
2.03	Crop-cutting (major season)	19-Jul-11	1-Oct-11	MoFA, IFPRI
2.04	Area measurements and interviews (minor season)	4-Oct-11	26-Nov-11	MoFA, IFPRI
2.05	Crop-cutting (minor season)	21-Nov-11	18-Dec-11	MoFA, IFPRI
2.06	Data collection for large scale and institutional farms	19-Dec-11	31-Jan-12	MoFA, IFPRI



3	Management, Financing, Logistics and Institutional Agreements			Responsible
3.01	SRID organizational review	31-Aug-10	31-Aug-10	MoFA, IFPRI
3.02	Institutional agreements	31-Aug-10	31-Jan-11	MoFA, IFPRI
3.03	Define district level organization model	31-Aug-10	12-Sep-10	MoFA, IFPRI
3.04	Define detailed budget for the 2011 GAPS	6-Sep-10	31-Jan-11	MoFA, IFPRI
3.05	Hire the GAPS project coordinator	30-Aug-10	31-Oct-10	IFPRI
3.06	Prepare meeting with ~20 District Directors of Agriculture in Accra	13-Sep-10	3-Nov-10	MoFA
3.07	Meeting of the ~20 District Directors of Agriculture in Accra	4-Nov-10	4-Nov-10	MoFA, IFPRI
3.08	Assess manpower and infrastructure in the ~20 GAPS districts	8-Nov-10	5-Dec-10	MoFA
3.09	Acquire equipment (GPSs, laptops, motorbikes)	4-Oct-10	6-Feb-11	IFPRI
3.10	Define equipment consignment policies	4-Oct-10	6-Feb-11	MoFA, IFPRI
3.11	Mid-term assessment	5-Sep-11	18-Sep-11	MoFA, IFPRI
3.12	Scaling-up recommendations	19-Sep-11	2-Oct-11	MoFA, IFPRI



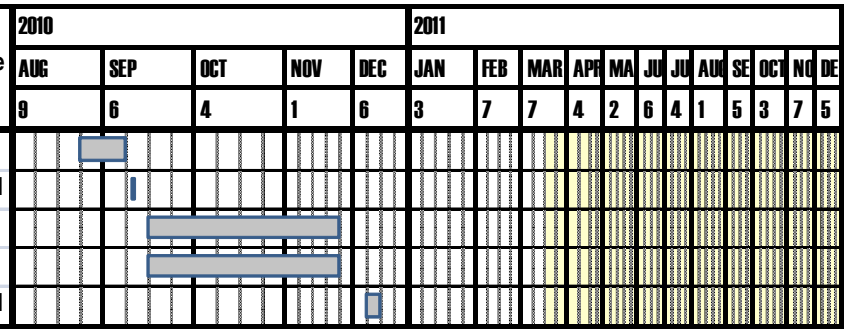
4	Development of instruments and methods			Responsible
4.01	Revise major season questionnaires	23-Aug-10	19-Sep-10	IFPRI, MoFA
4.02	Prepare first field-test	20-Sep-10	28-Nov-10	MoFA
4.03	Field-test major season questionnaires and procedures	29-Nov-10	5-Dec-10	MoFA, IFPRI
4.04	Adjust major season questionnaires and procedures	6-Dec-10	6-Feb-11	MoFA, IFPRI
4.05	Prepare manuals for the major season questionnaires	6-Dec-10	6-Feb-11	MoFA
4.06	Develop supervision procedures and forms	6-Dec-10	6-Feb-11	MoFA, IFPRI
4.07	Develop minor season questionnaires and procedures	7-Feb-11	5-Jun-11	MoFA, IFPRI
4.08	Revise agriculture modules of the GLSS	1-Aug-11	28-Aug-11	IFPRI, GSS



5	Sampling			Responsible
5.01	Get updated urban/rural population figures for 176 districts	30-Aug-10	12-Sep-10	MoFA
5.02	Select ~20 districts for the 2011 GAPS (VC)	15-Sep-10	15-Sep-10	MoFA, IFPRI
5.03	Get list of 2010 Census Enumeration Areas (EAs)	20-Sep-10	28-Nov-10	MoFA
5.04	Update list of institutional farms in the ~20 districts	20-Sep-10	28-Nov-10	MoFA
5.05	Select EAs in the ~20 districts for the 2011 GAPS	13-Dec-10	19-Dec-10	MoFA, IFPRI

6	Staffing and training			Responsible
6.01	Identify master trainers / field-testers	1-Nov-10	28-Nov-10	MoFA, IFPRI
6.02	Training of master trainers	6-Dec-10	19-Dec-10	MoFA, IFPRI
6.03	Prepare training logistics	20-Dec-10	6-Mar-11	MoFA
6.04	Prepare training program and materials	20-Dec-10	6-Mar-11	MoFA, IFPRI
6.05	**Train MEAs and METLs for the first season**	**7-Mar-11**	**20-Mar-11**	**MoFA, IFPRI**
6.06	Prepare training program, materials, etc. for the second season	21-Mar-11	4-Sep-11	
6.07	**Train MEAs and METLs for the first season**	**5-Sep-11**	**18-Sep-11**	

7	Data management			Responsible
7.01	Develop GAPS data entry program	20-Dec-10	6-Mar-11	
7.02	Debug the GAPS data entry program (concurrent with trainig)	7-Mar-11	27-Mar-11	
7.03	Specify district-to-Accra data transfer protocols	21-Mar-11	27-Mar-11	
7.04	Develop fieldwork quality assessment indicators	18-Apr-11	24-Apr-11	
7.05	Develop district model standard statistical report	8-Aug-11	5-Feb-12	



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Technical Addendum

Introduction

The following addendum provides a more thorough discussion for a number of important topics that were briefly introduced in the proposed Ghanaian agricultural statistics strategy. These include sampling, sequencing and organization of field activities, costing, and so forth. In many cases, the addendum is enriched by observation of the current MRACLS methodology and system that took place during a field trip to Dodowa, Akosombo, and Ho districts in August of 2010.

Sampling

MRACLS sampling strategy

This section describes the sampling procedures of the MRACLS, as they are normatively conducted at this moment (2010).

Selection of districts: Since the MRACLS is conducted in principle in all districts, district selection is not a part of sampling design. However, the number of districts in the country has grown from 138 in 2000 to 176 today, typically as a result of carving new districts out of some of the already existing ones. Prior to our visit to the field in August of 2010, consultations in Accra had indicated that the number of MRACLS fieldworkers had not been increased and that the subsequent sampling stages had not been modified accordingly. However, our visit to one of the split districts (Adaklu-Anyigbe was carved out of Ho in the Volta Region in 2005) contradicted that presumption. A new group of fieldworkers was recruited and trained in the new district, and the subsequent sampling stages were refreshed, both there and in the rest of Ho.

Selection of holders: Within each district, a random sample of 100 holders is selected each year in two stages:

- First, using the list of rural Census EAs developed by the 2000 Census as a sample frame, 10 EAs are selected with probability proportional to their population.
- Second, using an updated list of households in each of the selected EAs as a sample frame, 10 holders are chosen with equal probability in each EA.[10]

This two-stage strategy gives each holder in the district an approximately equal probability of being observed. The first stage was conducted around 2000 and (except in the split districts) it has not been redone. In other words, the MRACLS has been visiting the same EAs for the past decade. The listing of households is done each year.

Selection of plots: Within each district, all fields of all holders in the sample (around 200 to 300 fields in total) are identified and measured. Five of them are then chosen for each of the major crops in the district and, in each of them, a small square plot is designated for a crop-cutting experiment. The size of the plot ranges between 3m □ 3m and 9m □ 9m depending on the crop.

[10] Years ago, 20 holders were selected in each EA (200 per district), but at some point the number was reduced for budgetary reasons.

The choice of fields is supposedly random, but likely to be purposive in practice. The selection of a plot within each chosen field is randomized with the help of a special program in a handheld calculator.[11]

GAPS sampling strategy

The GAPS will use the current MRACLS sampling strategy as a starting point, but it will enhance it in many ways.

Selection of districts: District selection is not a concern of the MRACLS, but it will be a concern for the GAPS because the latter will only be conducted in roughly 20 districts. If the GAPS were only expected to provide national estimates, the best would be to select them with probability proportional to size, using the rural population as a measure of size, and with implicit stratification by region. However, that sample would be unable to deliver regional estimates and, in fact, some of the 10 regions might not be represented in the sample at all. To deliver rough regional estimates, the GAPS sample will be explicitly stratified by region, with two districts allocated to each of them.

Since the GAPS is also expected to serve as a benchmark of the procedures to follow for certain infrequent but important and geographically clustered activities, such as aquaculture or horticulture, it may be necessary to include some extra districts where such activities are conducted, as if they belonged to additional explicit strata. The survey may thus need to be conducted in a few more than 20 districts.

Sample size: With a sample of just 100 holders per district, the district level estimations of the current MRACLS are quite imprecise. For example, if 50 percent of the farmers in the sample use fertilizer, the percent of holders that use fertilizer in the district can be expected to also be around 50 percent. However, the margin of error of that estimation is at least ±10 percent, and probably more than that, as a result of clustering (the tendency of farmers from the same EAs to behave similarly in regards to the use of fertilizer). Even if there was no clustering, it could only be asserted (at the 95% confidence level) that between 40 and 60 percent of the farmers in the district use fertilizer.

The current two-stage strategy does not need to be changed, but to reduce the margin of error to about ±5 percent, a sample four times larger (400 holders) is needed. The GAPS sample will consist of 10 holders in each of 40 EAs. A sample of 20 holders in each of 20 EAs would have the same total size, but larger sampling errors because of clustering.

Paneling: The current MRACLS visits a different sample of holders each year. This procedure permits monitoring indicators over time, but both the richness and the precision of the analyses would be greatly enhanced if the same holders were visited in consecutive years – a technique known as *paneling*.

By following individual holders over time, paneling can ascertain *causality*, because it controls for unobserved characteristics. Cross sectional surveys can establish correlations between fertilizer use and yield, for instance, but such a correlation could be

[11] Fieldworkers use their calculators to compute the area of all of the fields they measure and to then select a few random points within each field, regardless of whether the field will or will not be chosen later for the crop-cutting experiment.

due to some unobserved soil characteristics. Panel data are able to control for this and thus to provide a more accurate estimate of the impact of fertilizer on yield. Panel data can also shed light on other issues of critical importance to research such as the degree to which transformation is taking place in agriculture, by controlling for unobserved effects.

Another important benefit of panel surveys is that they can measure changes much more precisely than a series of cross-sectional surveys. For instance, if two cross-sectional samples, each of 400 holders, tell us that the prevalence of fertilizer use in a district was 48 percent one year and 52 percent the following year, we cannot be certain that the prevalence has increased by 4 percent, because each of the estimations has a margin of error of 5 percent, and in this case the margin of error of the difference would be about 7 percent – more than the difference itself. But if the estimations came from the same panel of households, the margin of error of the difference would be much smaller, perhaps as low as 2 percent or less, as a result of the correlation of fertilizer use among the same farmers from one year to the next. This makes paneling especially valuable in impact evaluation or specific interventions.

Panels also have disadvantages. One is that the holders in the panel are, by definition, representative of the population at the time the panel was selected. Another is that the panel will not contain any new holders. This intrinsic shortcoming of panels (called *aging*) is worsened by the practical inability to locate all holders from one round to the next (called *attrition*). Attrition is partly due to objective realities (such as holders moving out, going out of business, or getting tired of the survey), and partly due to managerial difficulties (turnaround of survey managers, poor archiving, etc.). Another problem is that government benefits may be preferentially targeted to panel households, thus making them unrepresentative of the general population.[12]

A balance between the advantages and disadvantages of panels can be achieved by panel rotation – regularly refreshing a part of the sample, so that each holder stays in the panel for a limited time (generally two or three rounds.)

Although the GAPS will only be fielded in 2011, it will set in place the procedures needed to implement paneling in the GAPS districts the following year (and ideally in all districts from 2013 onwards). These will include:

- Careful recording in the survey databases of all the information needed to reliably track a holder from one year to the next (name, cell phone number, GPS coordinates of the dwelling and fields, etc.).
- Specific recommendations on the panel rotation strategy to be adopted in future years (which fraction of the sample will be refreshed, whether the new households will come from the same or from new EAs, etc.).

Selection of crop-cutting plots: The total number of fields subject to crop-cutting does not need to be increased, but their random choice needs to be properly specified and documented. The GAPS will do it as a by-product of the computer-assisted field edits (CAFÉ) of all raw data (see “Organization of fieldwork for data quality assurance” below).

[12] Preferential targeting is not necessarily malicious. It can also result from well-intentioned actions, such as having the survey fieldworkers play a secondary role as agriculture extension agents, health advisers, etc.

The technique now used by the MRACLS to randomly select a plot in each of the chosen fields is technically correct, but it is oriented to the measurement of field areas with surveyor tapes and prismatic compasses; thus it needs to be adapted to the measurement of areas with GPS devices. For each field in the sample, the fieldworker will be asked to record the area, the perimeter, and the coordinates of a single point in the approximate center of the field,[13] which will be flagged with a peg for future reference. If the field is chosen for crop-cutting, the random location of the plot will be specified in polar coordinates relative to this flagged point. Fieldworkers will then pinpoint the four plot corners using a prismatic compass and a surveyor tape, as in the current procedure.

Interpenetrating sampling: The GAPS will randomly allocate 10 of the 40 EAs in each district to each of the four fieldworkers responsible for data collection there (see "*Fieldwork methods*" below). This technique, known as *interpenetrating sampling*, entails slightly higher transportation costs than the alternative where each fieldworker covers his or her own territory within the district. However, it brings significant benefits in the control of non-sampling errors due to interviewer effects.

In the future, the MRACLS might consider regularly reshuffling the allocation of EAs among interviewers, so that each EA is visited by a different interviewer each year. This would have a few disadvantages, but it would serve as an additional factor to control interviewer effects.

Holders or households?: The current MRACLS records many household-level variables, but it only measures and inquires in-depth about the fields of one holder in each household. This technique is adequate for the estimation of agriculture production, but it may be insufficient for the understanding of households as economic units, as well as for analyzing the intra-household allocation of resources (such as seeds, irrigation, or fertilizer), especially from a gender perspective.

The GAPS will further explore these issues before specifying in detail how to select holders in each EA. The intention is not to select more than 10 of them, because that would increase the fieldwork effort, but to make sure that they belong to a common group of households rather than to separate households.

Sequencing of field activities, key materials, and instruments

Sequencing of field activities

The sequencing of the GAPS' activities is designed to follow the agricultural calendar in order to ensure that relevant information is collected at the most opportune time. In the south, the major season runs approximately from January through early September (where rain falls from March through July). This is followed by a minor season from September through December (where rain falls from September through November). The next section describes an appropriate sequence of events for the GAPS taking into account this agricultural calendar in the south of Ghana (see the calendar sequence on the following page for a visual depiction of this sequence).[14]

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[13] All four items (area, perimeter, latitude, and longitude) can be directly read from the GPS device.

[14] In the north rainfall is only present from May through October so there is only one agricultural season. Albeit the timing of GAPS activities would be distinct in the north, the sequencing should be fairly similar in

First of all, it should be noted some data collection activities overlap because: (1) the GAPS is designed to collect information during both minor and major seasons, which overlap in September, (2) agricultural activities during a specific season sometimes overlap with each other as well, and (3) in some cases it is necessary to administer surveys while an agricultural activity is taking place (such as crop cutting during the harvest), while in others it is best to allow for a brief period to pass (recall questionnaire of inputs used and crops marketed after the harvest). Secondly, it should be pointed out that this framework is essentially a flexible means for organizing the operation of this survey, not a rigid plan. Events on the ground will certainly impose that the schedule and sequencing of activities be adjusted to local circumstances.

The rest of this section occasionally refers to specific dates in the year 2011 when they correspond to scheduled tasks in the GAPS calendar of events. These dates have been defined precisely to serve as a concrete guide. Of course, in a specific agricultural year, the dates would not be defined so precisely in practice.

In general, holders prepare their land for planting beginning in January and ending in February. Next, holders plant their fields in March and April. Consequently, the third week in March (the 28th) is an ideal moment for fieldworkers (hereafter referred to as Monitoring and Evaluation Assistants, or MEAs) to visit EAs for the first time in order to publicize operations with local leaders and farmers, which is necessary to ensure that all future GAPS activities are well-received by the community. Following promotion, MEAs administer Form 1 (the household and holding listing enquiry) over a 6 week period through the first week in May (the 6th). Once this has been completed, the sample of 10 holders per EA that will be included in the forthcoming GAPS activities is randomly selected as a by-product of the computer-assisted field edits of all raw data (see “Organization of fieldwork for data quality assurance” below).

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most cases to those undertaken during the major season in the south. As such, with adjustments made for unique situations, the scheduling of most GAPS activities in the north would take place with a lag time of about 2 months as compared to activities in the south.

Proposed calendar sequence of GAPS field activities (by season):

		January	February	March	April	May	June	July	August	September	October	November	December
Major	Agriculture	Prepare	Prepare										
				Plant	Plant								
				Tend	Tend	Tend	Tend	Tend					
								Harvest	Harvest	Harvest			
								Market	Market	Market	Market	Market	
	GAPS		Promote	Promote									
				Form 1	Form 1								
						Form 2a	Form 2a	Form 2a					
						Form 3	Form 3	Form 3					
								Form 4	Form 4	Form 4			
											Form 2b	Form 2b	Form 2b
		Form 5	Form 5										
Minor	Agriculture								Prepare	Prepare			
									Plant	Plant			
									Tend	Tend	Tend	Tend	
												Harvest	Harvest
		Market	Market									Market	Market
	GAPS								Form 2a	Form 2a			
									Form 3	Form 3			
											Form 4	Form 4	Form 4
		Form 2b	Form 2b										Form 2b
		Form 5	Form 5										
# of GAPS field activities		3	3	2	1	2	2	3	3	3	2	2	3

From the time of planting through the time of harvesting, holders tend to their fields. May and June are months when this is their primary activity. As such, the second week in May (the 9th) MEAs begin the fielding of Form 2a (the household roster, dwelling, asset, and landholding enquiry) and Form 3 (the field location and area enquiry) to the 10 selected holders in each EA. Both of these forms are administered from the second week in May for 10 weeks through the second week in July (the 15th) as part of the same visit to the EA in order to maximize the efficiency and expediency of the process and to ensure they are completed prior to harvesting. For instance, MEAs can administer Form 2a in the afternoon and evenings when holders are at home and Form 3 the following morning when holders are tending to their fields. Once this has been completed, the sample of 5 plots per crop of interest in each EA is randomly selected, again, as a by-product of the computer-assisted field edits of all raw data.

Early harvests of crops begin in mid July and last through September, depending on the rain. Consequently, the administration of Form 4 (crop yield measurement enquiry) by MEAs begins for the selected plots in the third week of July (the 19th) and runs for 11 weeks through the end of the last week in September (October 1st).

Once the harvest takes place, holders begin to market their output. It is necessary for MEAs to wait for marketing to take place before administering the next form because it is designed to solicit information concerning the quantity, price, and location of sales. Fielding these questions at harvest time does not provide sufficient time for transactions to take place and will lead to collection of incomplete marketing information. As such, MEAs begin administering Form 2b (the agricultural production and marketing enquiry) in the first week of October (4th) after holders have harvested their crops and have had sufficient time to market their output. Form 2b is fielded for 8 full weeks through the last full week in November (26th) in order to allow for a sufficient marketing period and to ensure that major season data collection activities are completed prior to the start of December.

GAPS activities related to the minor season will follow a similar general sequence of events beginning with Form 2a in early August and ending with Form 2b through February, with alterations being made in unique cases. It should be noted that when the MET conducts data collection during the minor season it is for the same households and 10 holdings chosen as a by-product of the CAFE system during the major season. Thus it is not necessary to administer Form 1 again. On the other hand, the random selection of plots for the Form 4 that is administered during the minor season is generated as a by-product of the CAFE system taking into account the raw minor season data from Forms 2a and 3. In other words, a new random set of plots are cut for yield estimation from major to minor seasons.

Lastly, Form 5 (the commercial and institutional holding enquiry) is fielded once during the year, in January and February, to capture data for all major and minor season activities. Data collection from commercial and institutional holders takes place at the end of the minor season because, in general, these types of holders keep adequate records of their activities and outputs. January and February is a good time for MEAs to collect this data because both agricultural production seasons are complete by then and MEAs are not conducting numerous other activities. Form 5 is completed by the end of February in order to wrap up GAPS activities prior to the initiation of the following agricultural year's MRACLS.

Key materials

In addition to methodological upgrades needed to improve the agricultural statistics system, a number of key materials are also necessary for each district's Monitoring and Evaluation Team (MET). A MET consists of 4 Monitoring and Evaluation Assistants (MEAs) and 1 Monitoring and Evaluation Team Leader (METL). The list below is in addition to the long catalog of standard survey materials, such as paper, notebooks, pencils, calculators, etc., that are also imperative for the successful completion of GAPS. These vital materials include:

- 5 motorbikes and helmets to facilitate MET mobility,
- 5 handheld Global Positioning System (GPS) devices for field location and measurement,[15]
- 5 prismatic compasses and surveying tape sets to be used for designation of crop cutting plots, and
- 1 laptop computer for mobile data entry and quality assurance by the METL.

3.3 Questionnaire

In the process of developing this instrument, special attention has been given to refining the current enquiry forms, modules, and questions in the following ways:

- Sequence, efficiency, and linkage
- Depth and precision of information
- Comprehensiveness of agricultural (and relevant non-agricultural) topics

Organization of field work for data quality assurance

Understanding the field work procedures that are followed during data collection activities is imperative to ensure the quality control and credibility of the data collected. In the MRACLS and GAPS this implies ensuring that the data reflect the reality of what is observed in the field mainly through two mediums: human and computer based controls. This chapter discusses how both human and computer based supervision activities should be conducted in order to improve the quality of data collected by the MRACLS.

Current procedures

Survey instruments: Currently each district in the country samples ten EAs in which a set of five enquiry forms are administered by five trained district Extension Agents. Each extension agent is responsible for sequentially administering the five forms in two EAs throughout the year. The first form to be administered is the holding listing questionnaire (Form 1). This is currently done between January and February, and is preceded by a few days of publicity and

[15] Not all GPS devices directly calculate and provide area measurements, which is what is required to simplify and speed up the process of field area measurement. GPS devices that demand additional operations that slow down the process and provide an opportunity for human error, such as downloading or manually entering the measurement data into a calculator, should be avoided. Accordingly, the following GPS devices that can automatically compute area are recommended: Garmin Colorado – all versions, Garmin G-12 – late versions, Garmin G-12xl – late versions, Garmin VISTA – all models, Garmin LEGEND – all models, Garmin Venture – version 2.26 and up, Garmin G-48, Garmin G-60 – all models, Garmin G-76 – all models, Garmin G-V, Garmin GPS-176 – all models with latest firmware update, Garmin GPS-276C, Garmin Rino – all models, and Magellan Triton 500.

reconnaissance.[16] The listing operation is undertaken to create a list of all holders whose farms are located in the selected EA. This operation involves contacting all heads of households, recording their names, and asking them a few questions to determine what agricultural operations they have, if any. It is from this list that a sample of 10 holders is randomly selected by the supervisor.

The next form (Form 2) consists of the holder enquiry and is administered between February and March. This form solicits detailed information from holders on the structure, status, and characteristics of their holding. It also includes questions on the agricultural practices utilized and crops grown on the holdings. The holding enquiry is filled for each of the 10 selected holders in each EA. In practice, the fieldworker organizes visits with holders early in the morning before they go out to the farm or in the evening upon their return.

Between April and May, the farm area measurement form (Form 3) is filled for all fields of the selected holders. As opposed to the two previous activities, this activity (field measurement) takes place at the farm instead of the dwelling. The "Chain and Compass" method is applied in the measurement of the fields, but instead of the heavy chain a lighter plastic surveying tape of 100 feet or 30 meters is used along with a prismatic compass. This method consists of marking the perimeter corners of the field with pegs and taking the bearings and length from one peg to the next until the fieldworker returns to the original point (the bearing is the angle from one peg to the next in relation to the North – 0 degrees). Having measured the angles and distance along the perimeter the fieldworker inputs this information into software on a programmable calculator that provides the field area.

In practice we have observed that this is a very precise, but somewhat time consuming exercise because it necessitates help from another person (it requires two fieldworkers walking around the field twice, as well as the use of a calculator). The first time the fieldworkers go around the perimeter of the field in order to correctly mark all the corner points with pegs. The second time they move along the boundary from peg to peg measuring the bearings and distances using the prismatic compass and surveying tape. At the end of this process, fieldworkers also use the software in the calculator that takes into account the bearings, perimeter, and area to select a random point within the field for future use during crop cutting. They also generate more than one point in case the first point is not found in the field, which is of relatively low probability.

Finally, starting in June and lasting through December, crop yield enquiries (Form 5) are conducted progressively over time for a randomly selected sub-sample of plots (square plots within fields) for important crops (such as maize, rice, cassava, yam, cocoyam, and plantain) as they are harvested by holders. This process consists of counting crop density, cutting crops, and measuring yields (weighing with a scale) within a plot in order to estimate the total production of these crops by district, which allows for the calculation of regional and national production estimates. The supervisor chooses five fields per key crop in the district where plots will be identified and crop cutting will be conducted. For each selected field the fieldworker follows a predetermined procedure utilizing the random point generated by the calculator as a starting point for the designation of the plot area. From there they measure out a square of appropriate size (depending on the crop) using the prismatic compass and surveying tape. This

[16] The objective of this publicity is to inform local leaders and residents about the different phases of the MRCLS and the roles of the fieldworkers in order to facilitate full cooperation. The objective of reconnaissance is to verify the boundaries and contents of each EA and to document any changes, such as the names of new localities.

is completed just prior to harvest time based on communication with the holder, at which time the fieldworkers count the number of plants in the crop, harvest it, and then weigh it.

Supervision: Supervision is responsible for ensuring the accuracy and quality of the data produced by the MRACLS, which provides essential information for policy makers. One district supervisor is responsible for directing 5 fieldworkers and ensuring that they carry out their assignments correctly. Currently, supervisors combine both managerial field work quality control, which take place in the district office and in the field.

Prior to going into the field, the supervisor is responsible for organizing logistics, finances, and a host of other organizational and institutional issues. The supervisor is, for instance, in charge of providing the following materials required by the enumerators for their field work:

- Enumerator's Reference Manual
- EA maps for assigned EAs
- Prismatic compass and surveying (measuring) tape
- Clip board
- Household listing enquiry forms
- Holding enquiry forms
- Farm area enquiry forms
- Yield enquiry forms
- Pencils, erasers, roll ball pens, rulers, chalk, satchel, etc.
- Identification cards
- Visitor's book

During field work the supervisor is in charge of ensuring that the data are correctly collected. Therefore, the supervisor is required to perform a number of tasks at each stage of the survey. The supervisor is required to spend most of his or her time observing enumerators at work, assisting them when they come across challenges, and reviewing the completeness of their work (see details in the SRID supervisor's reference manual). This includes checking that fieldworkers visit the appropriate field location, complete questionnaires, and write down appropriate values. This is a considerable work load and, thus, this may require the supervisor to make spot checks at certain phases of the fieldwork. Nonetheless, the supervisor is still required to check all completed enquiry forms for completeness, accuracy, and legibility. In practice, the supervisor is also in charge of all data entry, which is done manually with a computer without clear guidelines to ensure the consistency and quality of the data.

Challenges posed by the current procedure

The field trip to three districts (Dodowa in Dangme West, Akosombo in the Eastern region, and Ho in the Volta region), revealed a number of procedural challenges that may affect both the efficiency of the survey and the quality of data. These are mainly related to the instruments and supervision.

Instruments: As noted previously, the holding listing form is administered for almost two months. Fieldworkers indicated that they have to rigorously follow the serial number assigned to households in each EA, which holds up the listing operation when a household head is absent. According to the procedures, fieldworkers cannot skip the household and come back to it at a later time because they do not know the number of holders in the household and therefore they cannot leave the appropriate number of empty rows to be filled out on the listing form. Consequently, they are required to wait until they find the absent head of the household and interview him or her before they move to the next one. This obviously can delay the listing process considerably.

The holding enquiry has not been administered in recent years, however fieldworkers reported that it was being fielded in 2010 in two out of the three districts visited (at the time Akosombo was still awaiting the resources to print the enquiry form). In general, when it is administered it takes place without major complications. This typically occurs between February and March, which corresponds with the planting season for most crops in the districts. This implies that the data collected in Form 2 on farm preparation, input use, sale of production, etc. would either represent the reality of the previous season for most crops or expected preparation, input use, and sale of production; neither of which are the best way to solicit this information. The former allows for too much time since the end of the season, which makes recall very difficult for the holder and the latter is only a rough estimate. In the case of the former, it would also be unsuitable because the farming production and marketing information would not be related to the information collected in Forms 3 and 4 for the current season.

The field measurement enquiry and methods are adequately conceived of and administered quite effectively. Although the tools that the methodology depends on provide very precise area estimates, they are also time consuming.

Supervision and data management: Both supervision of survey and data management pose serious challenges for the MRACLS. Currently supervision puts more emphasis in management of staff and logistics, but little is done concerning quality control. As a result data is not managed adequately because automated data quality checks do not exist and data is not processed in one consistent format. This allows for data manipulation at the district and regional levels before the processed data reaches Accra. In combination, this form of supervision, inadequate data management, and subjective data quality assurance increases the opportunity for human error to deteriorate the accuracy and quality of the data.

In Ho, the supervisor explained that quality control is often poor because the supervisor is not often able to follow each and every one of the five enumerators in the field to observe what they are doing. Time and logistical constraints were also mentioned as the reasons why the supervisor may not be able to improve quality control of the field work. Time is an issue, because the supervisor is responsible for overseeing the work of ten additional extension agents based in the district agricultural development unit (DADU), in addition to the five enumerators charged with collecting data for the MRACLS,. Logistics is an issue to the extent that supervisors sometimes lack the necessary means of transportation (vehicle or motorbike) to move around. Moreover, there is also a somewhat fundamental misunderstanding of what constitutes supervision. In more than one case, supervisors described observing and helping the fieldworkers as a means of supervision, which is not sufficient for data quality assurance.

Data entry is performed manually by the supervisor in a format of his or her choosing as no consistent format or software is used. In Akosombo, for instance, the supervisor claimed to have independently decided to enter data from the holding enquiry form in an excel sheet, while data from the field measurement enquiry was compiled ain word document. After data compilation, all the files and supporting documents are sent to the regional office where regional aggregates are computed before they are sent to Accra.

GAPS strategy to improve procedure

To improve procedures and hence data quality GAPS proposes the following procedural improvements:

Instruments: GAPS proposes to administer all 5 of the MRACLS enquiry forms, of which only three are consistently administered at this time (Forms 1, 3, and 4) following the sampling strategy described previously. In doing so, the following improvements are suggested:

- A new calendar for administering the questionnaires at the most relevant time (as previously presented in “Sequencing of field activities”), which should also improve the efficiency and effectiveness of data collection activities. For instance, the holder enquiry and field area measurements (Forms 2 and 3) should be completed during the same visit to the EA, instead of separately. In addition, Form 2 should be split into information that can be collected before the harvest and other data that should only be solicited after harvest and marketing.
- Revise the methodology used to complete the holding form (Form 1) by allowing fieldworkers to proceed with the listing even when one of the heads of households is absent. This will considerably speed up the process by using more paper instead of more time, the latter of which is at a greater premium in this process.
- Provide fieldworkers with modern tools such as the handheld GPS devices in order to reduce the time associated with field measurement operations. Requiring only one fieldworker to walk only once around a field instead of having two fieldworkers walk around the field twice, as with the current procedures. This will cut down the time required for this activity to one-fourth of the current amount.

Reorganize the enumerator assignment: Of the five current fieldworkers, GAPS proposes to choose one as a Monitoring and Evaluation Team Leader (METL) who will be in charge of supervision, data entry, and data quality control, and to designate the other four remaining fieldworkers as Monitoring and Evaluation Assistants (MEAs) who will conduct the fieldwork. Together, these 5 fieldworkers make up the Monitoring and Evaluation Team (MET). Under this structure, MEAs would be assigned 10 EAs each, in order to collect information in a total of 40 EAs per district.

The GAPS also proposes to have the MET work exclusively in survey data collection activities without performing any of the other tasks that agriculture extension officers generally undertake. This is required for two important reasons. First, by being completely dedicated to survey data collection, the MEAs and the METL will be able to complete the larger workload that is needed from them (40 EAs instead of 10) to produce data representative at the district level. Second, as explained before (see Section 2 of the proposed agricultural strategy, “Review of the existing agricultural statistics system”), combining extension tasks with measurement activities would intrinsically bias the information collected. This would defeat the purpose of this data gathering, since in that case the observed holders would always be better off than the average households in the district.

The METL will be responsible for:

- Interview observation: sitting in on household interviews as they are conducted to ensure that the instructions in the manuals and the recommendations given during staff training are being followed.
- Review of the completed questionnaires: determining if all the household members have been properly recorded, all relevant sections were completed for individual household members, and responses appear to be consistent.
- Data entry and error identification: using tailored software on their laptop that will notify the METL of any situations where the data value is coded incorrectly, out of range, or inconsistent with other responses. These notifications will take place both during data entry via the software, as well as after it is completed via printouts that the software automatically produces.
- Check-up visit: re-visiting randomly selected households and repeating parts of the interview with them.

- Timeliness: ensuring that all the activities are being completed in accordance with the work calendar and keeping in regular contact with the Core Team.

As such, the METL must ensure that all households in each EA are correctly listed. Random holder selection will be accomplished by the software, so this will not be a task the supervisor is responsible for (the same is the case for the plot selection). That being said, the supervisor will be responsible for notifying MEAs of which holders were selected. The supervisor must also check that none of the MEAs are tempted to invent data which have not been genuinely provided by the holders interviewed. Lastly, the METL is responsible for transmitting or sending the raw data directly to centralized GAPS Coordinators working for SRID and IFPRI in Accra.

Central supervision of field-teams' activities: Centralized supervision of METLs and field activities is an effective way to ensure that METLs and MEAs complete their tasks with sufficient precision and timeliness. It creates an additional layer of quality assurance for the cases when METLs may make mistakes or deviate from procedures in a way that will weaken the data. Examples of how this can be accomplished include:

- Cell phones can be used by GAPS coordinators and METLs to send SMS messages reporting the number of households found in the enumeration, and the actual dates on which fieldwork began and ended in each sample point. In addition, they can be used for random spot checks of questionnaires when holders are in possession of a cell phone.
- A centralized logbook can be kept to record operational problems such as an abnormal number of interview refusals, vehicle breakdowns, staff illness, and anything else which requires supervision or support from headquarters.
- The data recorded in the field should be sent to headquarters as soon as work has finished in each EA.
- After quality assurance measures have taken place in the field, a central unit led by one person can be set up to revise the quality of the data received from each sample point, to detect problems of incorrect coding or unresolved inconsistencies and provide immediate feedback to the field teams, with precise instructions on how to correct their mistakes.
- Operational problems and incorrect field procedures should be continually assessed and resolved, where necessary by sending a specific supervision mission to correct problems in the field.

Data entry in the field: GAPS proposes the integration of data entry into field work. In fact, modern surveys have promoted the integration of data entry into fieldwork since the mid-1980s, exploiting the advent of portable computers (laptops). The concept is based on entering data concurrently with fieldwork, with programs that detect errors and inconsistencies in the data recorded while the interviewers are in the field, so that they can be corrected by means of re-visits to the households. This technique is no more expensive than the alternatives. It is a tried-and-tested methodology which has been shown to work well in developing countries from Afghanistan to Zambia, by way of Côte d'Ivoire, Nepal, Niger, Timor Leste, and dozens of others.

To integrate data entry into field work GAPS proposes that the flowing steps be taken:

- Provide the METL with a laptop with adequate specifications and durability.
- Develop software for data entry specifically tailored to this survey's questionnaire, format, and needs. Doing this may pose some challenges, but the difficulty is not often in the programming of specific applications but in the customization of available tools to the specific needs of each particular survey. In fact, bespoke solutions created with basic programming tools should be avoided.

- Make sure the data entry program is completely ready before the teams go into the field, which means that the data-entry program must be thoroughly tested during the survey field test. Bugs in the system cannot exist at the time of fielding the survey, as fixing then can critically disrupt the timeliness of the operation.
- All the data management procedures, including the packaging of completed data for transmission to headquarters, must be fully developed before fieldwork begins.

It is more expensive and difficult to prepare data-entry programs for integrated work, instead of software for centrally entered data (for instance in a data workshop), because the activities must be planned much more precisely and carefully. The screens and warning or error messages need to be designed efficiently, and fine-tuned so that the operator's task is made easier so that the METL and MEAs can properly understand the conflictive situations which are detected, as well as how to best address them. All aspects of data management must be decided, with the data-entry program tested and debugged, before the survey goes into the field.

Funding

Fielding the GAPs will require approximately one million USD, which will primarily be devoted to fieldworker compensation ($300,000), fieldworker resources including those previously listed as "*Key materials*" ($400,000), and additional expenses including technical assistance and travel ($300,000). The following table provides a rough illustration of this approximation:

Estimated costs:

Category	#	Value
Fieldworker compensation		$ 3,000
Fieldworkers	5	
District subtotal		$ 15,000
Districts	20	
Subtotal		$ 300,000
Fieldworker equipment		$ 4,000
Fieldworkers	5	
District subtotal		$ 20,000
Districts	20	
Subtotal		$ 400,000
Additional expenses*		$ 300,000
Total		***$ 1,000,000***
*Technical expenses, travel, etc.		

Special considerations

Special attention will be paid to the following topics, which necessitate in-depth consideration for monitoring, evaluation, and research processes:

- Gender
- District feedback
- CAADP