STRENGTHENING IMPACT ASSESSMENT IN CGIAR (SIAC) PROJECT

Objective 2.1. "Organize the collection of crop germplasm improvement research related direct outcomes"

GUIDELINES FOR COLLECTING VARIETAL RELEASE AND ADOPTION DATA

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Working Draft, April 15, 2014[1]

[1]These guidelines were the focus of discussion in Agenda Item # 4 at the Planning and Inception Meeting in Bangkok, January 15-16, 2014. We thank Tom Walker, Sushil Pandey and Robert Tripp for their comments and feedback, and all the meeting participants for participating in the discussion and providing their input, which is reflected in this revised version.

SIAC Objective 2.1
Guidelines for Collecting Varietal Release and Adoption Data

These Guidelines provide a brief description of the procedures and data to be collected by the CGIAR Centers/CRP and their National Partners to satisfy SIAC project's Objective 2.1: 'Organize the collection of crop germplasm improvement research related direct outcomes.' These guidelines build on methods used by the DIIVA and TRIVSA projects[2] to achieve the following end result:

a) To assemble, document, process and clean data collected on varietal release and "perceived" varietal adoption at the national level for CGIAR-mandated crops in South, Southeast and East Asia, and,
b) To standardize "best practice" protocols for assembling varietal release and adoption data.

These guidelines are targeted towards both the Center/CRP focal points who will provide the oversight and supervision of the implementation of the data collection activities, and the NARS collaborators (also referred as coordinators/facilitators) who will be in-charge of implementing the activities in their countries. As such, this document emphasizes the relevant aspects of data collection for participant Centers/CRPs/NARS and should be regarded as a reference manual on key aspects of data collection for Objective 2.1, and should be especially useful for National partners. This will ensure consistency and comparability across Centers/CRPs/NARS but at the same time should allow enough flexibility to explore and adapt to Center-specific characteristics of their mandate crops and countries.

Following the DIIVA and TRIVSA methods, these guidelines are organized around the discussion of minimum data sets for each sub-activity. They are drafted for project participants and assume familiarity with the project. This document begins with a brief discussion of major crop-country combinations (section 1), follows with suggestions on data needs and methods to collect such data (sections 2 and 3), and concludes with a summary section (section 4).

1. Major crop-country combinations (CCCs)

The definition of crop-country combinations (CCCs) is key for Objective 2.1. While in Sub-Saharan Africa, food crops are spatially diverse in terms of their relative importance to caloric intake in general and to poor people's diets in particular, the dominant staple crops in Asia are rice and wheat. However, Objective 2.1 includes additional CGIAR mandated crops for the focused region such as maize, barley, sorghum, millet, groundnuts, chickpea, pigeon pea, lentils, cassava, potato, sweet potato, bananas, and forages. The SIAC project recognizes that different CG Centers/CRPs have different mandate crops and expects that each participating Center/CRP is committed to covering its assigned number of crop-country combinations, which will be the basis for developing the budget for Objective 2.1. A consultative process was used to identify the crop-country combinations listed in Table 1. These CCCs have been prioritized and put forward as the focus of 'tracking the adoption of improved varieties' under the SIAC project by the relevant Center/CRP. The criteria used to select the CCCs included the importance of the crop in terms of total area planted, importance of the country in terms of CGIAR research contributions, data gaps, linkages/capacity of NARS, the feasibility in terms of security restrictions/constraints, and available resources (i.e., budget constraint).

This list is not final, but is expected to change at the margin depending on data collection circumstances of specific countries for specific commodities/crops.

[2] We acknowledge consulting the authors and drawing from the following two documents: Walker, T., 2010. Guidelines for data collection for Objective 1 of the DIVA project. May 31; and Pandey, S.; Velasco, M. L. and Yamano, T. 2013. Scientific Strength in Rice Improvement Programs, Varietal Outputs, and Adoption of Improved Varieties in South Asia. Chapter 13 in Walker, Tom and Alwang, Jeff (forthcoming book), CABI.

1.1 Commodity coverage

Twelve crops have been selected for SIAC's Objective 2.1: rice, wheat, maize, barley, sorghum, groundnuts, chickpea, pigeon pea, lentils, cassava, potato, and sweet potato. All of these commodities are important in at least one country in the South, Southeast and East Asia regions and some are important in more than one country (e.g., maize, rice, wheat, potato).

Similar to the DIIVA project, commodity coverage is synonymous with the crop improvement mandate of the CG Centers. However, it should be noted that not all CGIAR-mandated crops are included in the Asia-focused SIAC project mainly because of low economic importance (e.g., finger millet) or the lack of progress in or attention to crop improvement as indicated by limited varietal releases that has translated into negligible perceived varietal change and impacts (e.g., bananas, cowpeas, common beans, fava beans and soybeans). Other omitted commodities pertain to non-CGIAR food crops that are sub-nationally and nationally important (for e.g., mung beans, black gram, and peas).

1.2 Country coverage

The countries included in Objective 2.1 cover the region of interest. Within each country, any data reported – unless otherwise specified – should be considered nationally representative. However, it is also expected that the data will be collected at sub-national (e.g., geographical/agro-climatic regions) levels. The only two countries for which data would be collected and recorded at different levels (not nationally representative) are India and China. In these large and populated countries, the information should be representative of the selected state (India) or province (China) level, as indicated in Table 1.

2. First Data Base: Documenting modern varietal output

This is one of the core data bases for SIAC Objective 2.1 and should include all modern varietal outputs recorded in a formal national (or state/provincial in the case of India/China) commodity varietal release list/data base or is identified by experts as an adopted variety during the expert elicitation process (described in section 3), but which may not appear in the released variety list. For the purpose of this study, a modern variety is defined as 'a variety developed by breeders in the formal system.' It represents an output or contribution of the national and/or international public and private sector research systems.

The minimum data set for the varietal release data base consists of the following five descriptors: (1) Official name of the released variety, (2) Year of 'formal' release (or year of first use, in case of non-released varieties included after the expert elicitation process), (3) Institutional source of the released material, (4) Genetic background (usually pedigree or related ancestry information), type of material or varietal attributes, (5) Role/input of NARS/Centers/other research programs. Other desirable descriptors that can be collected for the varieties identified in the adoption database include:[3] (6) average experimental yield (or other characteristic advantage) of a given variety; (7) an assessment of whether the variety is in the increasing, peak or declining phase of the adoption cycle, and if in the declining phase, the year when a particular variety reached its peak adoption and what was the level of adoption at its peak; (8) seed multiplication: data on amount of breeder, foundation and certified/quality declared seeds multiplied and distributed in the last 5 years; and (9) whether the variety was developed using any modern molecular tools (i.e., marker assisted selection, biofortification, transgenic technology) and is protected under any plant breeders rights, patents or similar intellectual property rights regimes.

[3] We understand that some of these type of information may be difficult to collect for all the varieties across all the crops. However, attempts should be made to collect this type of information for as many varieties as possible that appear in the adoption database.

Next, each of these items is described, and examples of what the minimum data base entail are given in Table 2.

2.1 Official name of the released variety

The key consideration in assembling the varietal release data base is its inclusiveness: it should reflect all the varieties that are on the national list irrespective of the origin of the variety and year of release. The name of the released variety that appears on the national release list should be the identifier used in the varietal release data base. It is useful to record (in a separate field) any CG-Center identifiers/codes for the released variety or whether that variety was released in other country/state under another name), but that information is not essential and should not be deployed to substitute for the official name of the released variety.

2.2 Year of 'formal' release (and year of first use)

Recording year of release seems like a trivial exercise, but two substantive issues are relevant to describing the year of release. First, when does the release data base start for so called 'modern varieties'? As a general guideline, it would be informative to report the years of all releases including those in the 1960s and 1970s. This means that NARS/Centers/CRPs should assemble as comprehensive data base as possible in terms of the timing of varietal release. Secondly, NARS/Centers/CRPs could also report varieties in the pipeline that are likely to be released in 2014 (or in the next 12 months), but that are already being grown by farmers in their fields. The latter could be useful information and it is up to the NARS/Centers/CRPs to record it in a uniform manner if they deem it important. If recorded, such pipeline information should also be inclusive and refer to both CG-Center related and non-CG Center related potential varieties. However, varieties that may be released (but that are not being used by farmers yet) should not be included since these may never be released.

Recording both released varieties and potential releases in the pipeline could be informative for identifying varieties in the expert panel on perceptions of adoption discussed in Section 3 below. It is probable that farmers grow some of the oldest released varieties and several finished cultivars still in the pipeline as NGOs may diffuse improved varieties on a large scale prior to their 'formal' release in some countries. The term 'formal' release refers to the year when a particular variety is formally released, which generally (but not always) entails a ceremony where farmers, government officials and other stakeholders are invited to attend, and seed of the variety is made available in the market. In cases where varieties were diffused prior to their formal release (or were never released, but appear in the adoption list), it will be useful to record the approximate 'year of first use' (by farmers in that country) as a separate field. As a good practice this information should be also recorded for 'released varieties' that may be in use prior to their official year of release.

2.3 Institutional source of the released material

As its name implies, this descriptor is intended to record information on where the variety came from. That is, which institution (public or private sector) bred/supplied the material for its release (i.e., who made the last cross or who registered the variety and is listed as the institution releasing the variety in the official variety registration list). It is important to note that this item applies only to the released material itself. Therefore, collecting information on the institutional source of the parents of the released material is too detailed to be considered in the minimum data set and should not be recorded in this descriptor.

2.4 Genetic background or information on the parents/population of the released variety, type of material and varietal attributes

When a variety is released, data on ancestry is generally made available. These data are valuable in understanding uniqueness, sources of genetic gain, distinctiveness and novelty of traits, and research spillovers. Following DIIVA, for most crops included in SIAC's Objective 2.1, pedigree information on the name of the male and female parents is what the minimum data requires if the released variety was institutionally bred by a public sector. Missing information on ancestry is common in national release lists and necessitates some interdisciplinary tracking with plant breeding specialists. Incomplete information on parentage weakens any evaluation of what worked for released varieties that have a good track record of adoption documented in Section 3. It is

acknowledged that recording this type of information will be a challenge for private sector varieties. But all efforts should be made to document this descriptor at least for all the public varieties.

In addition to the genetic background this descriptor should also include (in a separate sub-field) information on type of material or varietal attributes, where such information is relevant and available. Under type of material, the descriptor should include information on whether the variety is hybrid or OPV, type of habitat it represents (e.g., upland, lowland, bush type, climber, etc.), and unique attributes in terms of traits (e.g., resistant to disease xyz, cooking quality, nutritional quality, etc.).

2.5 Varietal release classification in terms of role/input of NARS/Centers/other research programs

Each participating Center/CRP should come up with its own varietal release classification depending on the attributes of the crop and the breeding context. In general, the more disaggregate the descriptive classification the better. Major dimensions of the classification include the role of NARS, Centers/CRPs, and private-sector participation in the breeding process. Potentially, biotechnology offers the possibility of expanding the number of categories in the classification if any varietal releases are related to marker-assisted selection (MAS) or transgenic varietal change.

As an illustration, the following categorization by ICARDA for barley was representative of many Centers in previous initiatives (such as DIIVA), and could be adapted for the SIAC commodities:

- ICARDA-cross, ICARDA-selection
- ICARDA-cross, NARS-selection
- NARS-cross, ICARDA-parent
- ICARDA germplasm accession
- NARS-cross, NARS-parent
- Other international sources

2.6 Other desirable information

The minimum data set on varietal release excludes a considerable amount of information that could be collected with the goal of aiding in tracking the adoption of improved varieties, and/or extending the analysis beyond adoption to include other types of impact analysis. As discussed earlier, some Centers/CRPs could gather data on varieties in the pipeline (that are already grown in farmers' fields but not yet released). Additionally, we would encourage NARS/Centers/CRPs to collect data on the following types of descriptors for as many varieties as possible, but especially for varieties identified in the adoption database or for which significant adoption has occurred.

a. Average yield (or other superior characteristic/trait advantage) based on experimental data or results reported/published in official variety release documents. When reporting yield data, it will be also important to report the basis for these yield estimates (e.g., experimental stations or farmers' fields or survey data) and the yield of the local check (if yields are reported as a percentage yield advantage)
b. Assessment of adoption lifecycle: An assessment of whether the variety is in the increasing, peak or declining phase of the adoption lifecycle would be useful information to have in the dataset. If a variety is in the declining phase (at the time of data collection), the year when a particular variety reached its peak adoption and what was the level of adoption at its peak (as a % of cropped area, in a defined geographic region) should be recorded. We recognize that collecting this information will depend on the knowledge of the expert and there will be no way to corroborate this unless household data is used. However, we consider that it will be important to attempt to collect this information in the best way possible.
c. Seed multiplication: Data on the amount of breeder, foundation and certified/quality declared seeds multiplied and distributed in the last 5 years can help gauge the 'demand' for a given improved variety and help correlate with its relative adoption by farmers (see considerations/details in section 3.3.3).

d. Information on whether the variety was developed using any modern molecular tools (i.e., marker assisted selection, biofortification, transgenic technology) or through participatory plant breeding method, or is protected under any plant breeders rights, patents or similar intellectual property rights regimes. This type of information can contribute to an institutional assessment and technology content analysis of the plant breeding sector across different commodities and countries and relate to the evidence of adoption and impact of improved varieties.

This additional information should be recorded in separate columns after the required information is collected. Each NARS/Center should tailor the release data base to its own ends while respecting the need to assemble and preserve the minimum data base for system level objectives.

2.7 Guidelines on data base format, accompanying report and potential data sources

The data base on varietal release should be compiled in an Excel spreadsheet with descriptors as columns and varieties listed as rows. In addition to the five minimum and other desirable descriptors noted above, each data table should include the name of the crop, country (and the name of the state/province in case of India/China), the person with institutional affiliation responsible for collecting the data, and sources of data consulted for a given record. This additional information should be recorded as separate columns.

The Excel data tables should be accompanied by an analytical discussion/description of the database, called the 'accompanying report' (there will be two such descriptive reports, one for each database). This report should be brief and, in addition to the analytical discussion, should include any relevant information that could help understand the findings and/or any observations/issues faced during data collection.

Table 3 provides a guideline on potential data sources that can be consulted to compile the varietal release data base. For many minimum descriptors, the information can be obtained from the national varietal release or variety registration lists. However, the national release data in and of themselves are often not sufficient to establish a complete minimum data base. One or another aspect may be missing for some varieties and requires additional effort to satisfy the criterion of completeness. National release lists often suggest periods of stability punctuated by activity bound by long periods of inactivity. Commenting on why national release was variable over time should be included in the accompanying report (described above) of these data sets.

3. Second Data Base: Documenting the "perceived" adoption of modern varieties in 2013

3.1 Characteristics of the database

This data base is key to achieve Objective 2.1. The goal is to come up with a database of estimates of "perceived" adoption of improved varieties in the most recently completed agricultural year for all the CCCs. The database should have following characteristics defined by the ideal and the minimum data requirements (where applicable):

1. **Variety specific:** This will be a variety-level database, not just an estimate of adoption of 'improved varieties' as a group. Ideally, the information must be collected for <u>all</u> improved varieties (related or not to CG Centers/CRPs). Adoption rates of local varieties should be provided as a group and not specific for each local variety. However, if possible, for the most important one or two local varieties, their individual adoption rates (as a proportion of the total area under the respective crop) should be reported to better understand the characteristics of these local varieties that make them widely acceptable. The minimum data should include information about Center-related varieties (individually; see sections 2.3 and 2.5 for classifying a variety as "center-related") and integrated information for all improved varieties (as a group) irrespective of their source. This will allow estimating the performance of crop genetic improvement in general and to differentiate between adoption of Center-related and non-Center-related improved varieties.
2. **Spatially representative:** The database should give estimates of variety specific 'adoption' rates that are expressed as 'proportion (or percentage) of **<u>total area harvested</u>** of a given crop at the level of a **<u>spatially representative geographic unit</u>**.' At minimum, the spatially representative unit should be the highest

level of geographic area, which is the country as a whole. In the case of India and China where the coverage of this Activity is focused on selected states/provinces, the data should be representative at the state or province level. However, as noted in the methodology section below, for many CCCs, such aggregate level estimates will need to be first collected at some lower disaggregated level of geography defined either by administrative or agro-climatic units. Thus ideally, the database should provide variety specific adoption data at a level of disaggregation that is smaller than a country that makes most sense for a given crop and country.

3. **Temporally representative:** The database should give estimates of adoption rates that will be representative of the last completed **agricultural year** (AY), defined as a 12-month period. The year for which the data is representative should be clearly specified during the data collection procedure. If the crop is grown in multiple seasons that lie within the calendar year, this should correspond to the year 2013. If the crop is grown in one or multiple seasons that fall across calendar years, the adoption estimates will correspond to either AY 2012-13 or 2013-14 depending on when this activity is conducted. In some cases, specific varieties may be grown in specific seasons (when more than one season is possible in a given agricultural year). In these cases, ideally, data should be collected for each season (i.e., temporally disaggregated level) and expressed as a proportion of area grown in each season. This will facilitate the transition to a national-level estimate for the AY that will be weighted by area planted to a given crop by seasons.

3.2 Defining the scope of 'improved varieties' to be included in the varietal adoption database

What constitutes an improved variety is perhaps the most important aspect of adoption-level estimation. In the context of the varietal release database discussed earlier, we defined the scope of that database to include 'varieties developed by breeders in the formal system' and represents outputs/contributions of the national and/or international public and private sector research systems. However, in the context of the adoption database, this definition needs to be 'qualified' to take into account issues related to the release status of the variety in a given country and seed recycling behavior. For both these qualifiers, we discuss the importance of using a consistent definition of 'improved variety' at least for a given crop across all countries, and ideally across all CCCs.

Formal release status of a variety: Similar to the scope of the varietal release database, the adoption database should include all improved varieties, irrespective of their year of release or year of first use.[4] The issue of whether varieties released prior to certain cut-off year (e.g., 1960 or 1980) can still be considered 'modern variety' in coming up with the estimates of improved varieties in year 2013-14 will be addressed at the time of data analysis and should not dictate the inclusion or exclusion criteria at the stage of compiling the varietal adoption database. However, an important issue that should be considered at the stage of compiling the varietal adoption database is the formal release status of a variety. Should a variety that does not appear in the formal varietal release database be included in the adoption database? These refer to escapes, products of participatory varietal selection from improved materials, varieties that may be released in other countries/regions but were never formally released in the focused CCC, and varieties in the pipeline (i.e., undergoing the formal release process). Excluding these varieties and focusing only on 'released varieties' would understate the performance of investments in crop improvement. Thus our guideline is that if a variety meets the following criteria, it should be included in the adoption database. These criteria include breeding outputs in countries that do not have a functioning formal release and registry system.

Criteria for improved variety inclusion:

- The variety was identified by a 'name' during the data collection process, and this 'name' is not associated with a local variety

[4] We propose to take this 'all inclusive' approach to ensure consistency with the two databases and to allow for robust analysis.

- The variety would not be available to farmers without research in crop improvement (broadly defined to include crossing and/or selection)[5] irrespective of the country or institutional source of such investments and efforts

To ensure that we have the minimum data for all the varieties, any variety that meets these criteria and will appear in the adoption database, should be also included (after the fact) in the final varietal 'release' database. For these non-released varieties, the minimum data should include all the descriptors discussed in Section 2, except in the 'year of release' field, this variety should be identified as 'not formally released' and a 'year of first use' should be recorded in a separate field.

Seed recycling status: The genetic content and quality of an improved variety depends on the number of years a planting material has been re-used or recycled from harvested grain (or roots/tubers) rather than purchased as fresh 'seed.' For self-pollinated crops the 'shelf life' of an improved variety can be long and the seed used as planting material can still retain the genetic quality even after several generations. However, for many open pollinated varieties and propagated materials, the genetic quality deteriorates rapidly with each generation of seed re-used from previous harvest. For hybrid materials, the shelf life is the shortest and it requires renewal of seed stock every season. Thus, the issue of the frequency of seed renewal in defining varietal 'adoption' is important in ensuring comparability of data across varieties and CCCs. We are interested in differentiating between the genetic quality rather than the seed quality (which also affects the performance of a MV).

The following guidelines should be used in defining the scope of 'improved varieties' based on the seed recycling status when compiling the varietal adoption database of different types of crops.

Criteria for exclusion (use this as an example of a guideline, not a rule since this will be crop-specific. The CGIAR Center/CRP focal point should consult with the breeder or a seed expert to determine the appropriate number of seasons of recycled seeds in these exclusivity criteria for their specific crops):

- Open Pollinated Varieties (e.g., maize): Seeds recycled more than 3 seasons (this will vary by crop and the Center focal point should consult an expert on that crop to determine the appropriate timeframe, and apply that **consistently to all the countries for that crop**)
- Hybrids: Seed not purchased every season
- Varieties of self-pollinated crops (e.g., wheat, rice, barley, pulses): No restriction on the number of years a seed material is re-used from previous harvests

3.3 Methodology for collecting "perceived" varietal adoption data[6]

Various methods can be used to generate variety-specific adoption database that we are ultimately seeking to generate through SIAC Activity 2.1. These include one or a combination of: farm level surveys, seed sales data, and expert opinion. None of these methods are perfect and each has its pros and cons (Table 4). These methods differ in the cost of data collection and the accuracy of resulting estimates of adoption of individual varieties. Both of these features also affect the sustainability of an approach for tracking varietal adoption over time (i.e., periodic updates). The 'expert opinion' may be a low cost method of eliciting variety level adoption estimates, but the estimated values usually have a higher range of confidence interval. On the other hand, sourcing this information directly from the adopters may provide more accurate adoption estimates but the cost of collecting this information from a representative sample of all the farmers growing crop X in a region/country is much higher than 'expert opinion' surveys. Estimating variety specific adoption based on seed sales data may be one of the least cost options and ranks high on the criterion of sustainability of generating these estimates over time.

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5 Varieties that undergo only the selection process (i.e., are not an outcome of the deliberate crossing of two parent lines by a breeder) and 'released' as a variety should be included in the list, and identified as a selected material or an improved landrace variety in the pedigree information.

6 This discussion is not relevant to CCCs where there have been recently completed or planned (nationally representative) field based adoption surveys. However, for such CCCs, we still require the final outputs of variety release database and variety specific adoption database (as described in step 4 under section 3.3.1).

However, availability of data and the reliability of estimates based on such data in CCCs where informal seed system (i.e., seeds saved from harvested grain, accessed from community-based seed growers or purchased as grain) is likely to be a major source of planting materials used by farmers, are its major limitations.

From a practical point of view, the method to be used to develop varietal adoption data under the SIAC project will be dictated by cost considerations. Using the best method to collect varietal adoption data for each CCC based on the criterion of 'accuracy' alone may be beyond the means of this project. However, keeping that goal in mind, we recommend that each CCC use the method that gives the most accurate and reliable estimates of varietal adoption for the available resources. Within the budget constraint, we encourage NARS and Centers/CRPs representing each CCC to explore several methodological approaches that meet the 'minimum data quality' requirement of the SIAC project, and which will generate database with characteristics defined in section 3.1 and 3.2. These methodological options are described below in ascending order of desirability based on the principle of rigor. It is likely that a majority of CCCs will use the first and the most affordable approach on this list, which is based on 'expert opinion.' This was also the main method used by the DIIVA and TRIVSA projects, and is described below is more detail than the other methods, which include estimating varietal adoption using field surveys, seed sales data, and some variation and combinations of all three methods combined. These other options are included in this Guideline to provide flexibility to NARS and Centers to explore more rigorous methods, if budget permits. However, at this stage, these other methodological options are simply mentioned in this Guideline document, and not explored in great detail. If some NARS/Centers find opportunities to leverage resources or can piggy back on ongoing activities to be able to use these other options in a subset of the CCCs, MSU will work with them to ensure that such efforts are based on best practice guidance.

The role of the Center/CRP focal point will be to develop and/or review the data collection process (most likely based on method 1) and plan for conducting expert elicitation (if method 1 is used) in all the CCCs, to ensure that the NARS researcher conducting the panel discussion (under method 1) is trained in this method, and to provide supervisory role for ensuring adherence to set guidelines. To aid the Center/CRP focal point in this role, it is recommended that each NARS collaborator prepare an implementation plan and submit this to their respective Center focal point for review, feedback and approval**.** To play the supervisory role effectively, it is also recommended that the Center/CRP representative participate in expert panel meetings in some or all CCCs (depending on time and resource availability). However, we expect that a well-trained researcher from the NARS will take the main responsibility of leading all the steps and conducting the data collection with technical support and backstopping from the Center (and MSU, if required). **It is highly recommended that the Center participants send to MSU: 1) the implementation plan (i.e., who will conduct the expert elicitation process, when/where the expert elicitation will take place, the experts to be invited, what type of background data will be provided to them, what method will be used, etc.) for the first country where the EE method will be applied; and 2) the data base results for the first country undertaken so that feedback could be provided. This request only applies to the first priority combination and is expressly for the purpose of providing feedback.**

3.3.1 Method 1: Estimating "perceived" varietal adoption based on expert opinion

The elicitation process based on expert opinion surveys should broadly follow the following step-wise process largely derived from the DIIVA and TRIVSA project experience. Note that steps 1 and 2 are not strictly sequential, and some of these sub-steps may occur concurrently. However, steps 1 and 2 must precede steps 3 and 4. Further, there must be at least one person in charge of conducting the expert elicitation process. This person (or group of people if more than one person will play this role) would most likely be a NARS researcher or the link between the NARS and the CG Center. Throughout this document, we will refer to this person as the 'facilitator.' The following steps are intended for the facilitator, but also for the Center/CRP focal point who will play supervisory role and will be in-charge of the quality and consistency of data collected across all CCCs.

Step 1: Pre-elicitation prep work

a. Ensure that the historical information on varietal release has been updated and is available. In other words, the varietal release data base precedes and lays the foundation for the assessment of adoption perceptions.

b. Canvass background evidence on recent adoption studies and variety-specific seed distribution and sales. Synthesize this evidence and share it with your Center/CRP focal point to jointly develop a plan for eliciting varietal adoption data for your CCC. Have this material ready for use as resource/background material in the elicitation process with experts (but do not show it to experts before they have provided their initial estimates of adoption since this may bias their answers; instead, use it during the discussion). This will also serve as background information in your accompanying descriptive report (see step 4a).
c. Consult experts (see definition of 'experts' in Step 3a below) of your focused crop and come up with exclusion criteria in defining the scope of 'adoption of improved variety' based on the seed re-use behavior by farmers as per the guideline in section 3.2.
d. Collect data on nationally representative area harvested *(A)* for a given crop *c* by season *j* (such that $A_c = \sum A_{cj}$) from available secondary sources (i.e., agricultural statistical office) for different levels of geographic disaggregation and representing the latest year or an average of the last three years available. Compare the estimate of A_c against data from FAOSTAT. If there is a large discrepancy, make a determination of which estimate will be used and document the reasons for selecting a specific data source for area estimate.

Step 2: Define the geographic units for collecting varietal adoption estimates

a. Convene/consult researchers (usually NARS crop improvement scientists of the commodity of interest and people with extensive field-level knowledge of varietal technology adoption) to define the geographic units that will be the basis for estimating varietal adoption.
b. Seek the knowledge/expertise of this group of researchers in dividing up the country (or state/province) in to distinct (non-overlapping) adoption domains, D_i, where *i* could be as few as 2-3 or as many as 10 or more, depending on the type of crop, the size of the country, and availability of disaggregated area harvested data. These 'domains' 1) could be crop specific and defined by variables such as rainfall, elevation, type of farming system, use of irrigation and other technologies, etc., or 2) could be general for the agriculture sector as a whole based on some country-specific or global definition of major agro-climatic zones; or 3) could be simply based on geo-political or administrative units (such as province, region, district, etc.). A major determining factor on which definition is used to define the adoption domains or geographic units will often depend on the availability of data on 'total area harvested' for a given crop at that level of a geographic disaggregation. Once defined, these geographic sub-regions or adoption domains should be fully described in the form of a map or a descriptive list that ideally includes an exhaustive list of sub-administrative units that fall within each domain (to ensure there is no over-lap between the geographic sub-regions).
c. Assign relative area to each sub-region *i* by season *j* (such that $A = \sum A_{ij}$).

Step 3: Elicit 'expert opinion' judgments of varietal adoption representative at the level of A_{ij}

a. Convene a panel of 'experts' – those considered to be fairly knowledgeable about varietal adoption for the respective crop. Typically, an expert panel should consist of researchers consulted in step 2a (i.e., NARS and/or Center breeders, crop management scientists), extension workers, seed traders, local agricultural officers, representatives of NGOs active in technology dissemination efforts and other individuals knowledgeable about the particular crop production systems in the country by sub-region. Consult with the Center/CRP representative to jointly make a decision about the composition of the expert panel for your CCC. This could be one national level panel that provides adoption estimates for all the sub-regions by season combinations (i.e., all A_{ij}) in a country or there could be different panels focused on specific sub-region by season combination. In the latter scenario, Step 3 should be repeated for each of the sub-region by season combination. If the budget allows it, organizing a field day for experts to interact with farmers and learn about the varieties used may be a useful activity so experts can "adjust" their prior beliefs before conducting the expert elicitation process.
b. The facilitator and panel members should prepare ahead of time (prior to the meeting) so they can be prepared to give their opinions and some evidence to support them. Since in many cases, experts may be region-specific, it may be necessary to conduct meetings with several panels of experts in different regions of the country/state/province. If there are experts who can provide information at the highest level of disaggregation required (e.g., country or state/province), these experts may participate in each of these

regional meetings. One alternative to conducting many (spatially and temporally separated) regional meetings is to meet in one central point at the same time (i.e., all regional experts meet together) for eliciting estimates disaggregated by regions or sub-regions and then aggregating those at the national level as a meta-panel. At these meetings the purpose of the activity is explained and definitions provided, e.g., what constitutes an improved variety (see section 3.2). Background information gathered in step 1b is shared with the panel members (as appropriate, but preferably after the initial estimates are provided).

c. Elicit from the experts a list of all the improved varieties they perceive farmers are currently growing in a given sub-region. Make an exhaustive list of all the improved varieties (h) believed to be currently adopted by farmers and compare that to the list of released varieties. If any variety on the list generated from expert elicitation is not on the varietal release list, determine whether it is a non-released improved variety or a local/traditional/landrace variety. If it is a local/traditional variety drop that variety from the list. If it is an improved variety, collect information on other descriptors and update the varietal release database. This may be also an opportunity to verify or collect any missing information for descriptors in the varietal database such as average yield, adoption trend, etc. for all the varieties appearing on the adoption list.
d. In each sub-region, elicit perceptions on the percentage area under all improved varieties (IV) and local/landraces (L) in the domain (such that IV + L = 100). In eliciting estimates of IV, explain the exclusion criteria in defining the scope of 'adoption of improved varieties' for the focused crop.[7] Ask each expert to document or explain the basis of his/her perception of IV. The estimate for IV could (and likely will) be adjusted after the panel discussion, if needed.
e. Next, within the group of improved varieties, ask the panel members to rank specific improved varieties identified in descending order of popularity. The reference point for the ranking is 100% of the crop's harvested area in a given season in the sub-region (A_{ij}).
f. After the ranking is done, ask each expert to allocate the estimated area under improved varieties into variety-specific proportional areas for the most recent cropping year (V_h). This could be conducted by asking each expert to write on a card the % adoption for each variety (or all varieties at the same time) and a brief explanation about what is the basis for each estimate.[8] Then, the cards can be collected and posted on a board for discussion. Compare/discuss these estimates and come up with a consolidated list of varieties ranked in descending order of adoption rates. The facilitator could present the secondary data during this discussion to modify/support the estimates (though it all depends on the representativeness of the secondary data). If the consolidated list of improved varieties is long, all the varieties that do not fall in the top x% of IV adoption area can be grouped as 'other improved varieties' and given the residual share in the total percentage area under improved varieties. The facilitator should use his/her judgement on what the value of x should be relative to the number of varieties on the list, but as a rule it should not be less than 90% of the total area under that crop in the sub-region. The end result should be an estimate of V_h for all IVs, such that $\sum V_h + L = IV + L = 100$. Illustrative instruments to elicit these estimates from individual experts and a consolidation form to record the expert panel's agreement on final estimates are provided in Table 5.
g. Discuss areas of discrepancies between the background information you would have collected (step 1b) and the elicited perception and revise the perceptions if the discrepancies are large and if revisions are warranted.
h. The final estimates of V_h should reflect the consensus of the panel. Note that consensus should not be reached because of tiredness. Instead, the panel facilitator should "facilitate" the discussion so a consensus can be reached based on evidence and explanations. Highlight issues of greatest uncertainty and disagreement in the perceptions of % area; note ranges where uncertainty is greatest. In such cases better "triangulation" of the information will be needed. Record the explanation/source of information

[7] For example, if experts know that in a particular region, farmers plant an improved variety that is open pollinated variety (OPV) and that this OPV was introduced in the region five years ago and no other seed sales/distribution has happened, they would not consider this under IV. Instead, they would record this adoption rate under L.

[8] If the expert is refuting/criticizing a statistic, be sure to include this statistic (and its citation) in the background information and to discuss the reliability of the said statistic.

used in support of a consensus M, and all V_h. The documentation of explanation/information in support of the 'perception' of varietal adoption provided by the panel should be submitted as part of the adoption data table.

Step 4: Reporting the results

a. Draft a brief 2-4 page report (i.e., accompanying descriptive report for the second data base) documenting the substance and the process (composition of the expert panel, their email contact information, description of the sub-regions, background information on adoption (step 1b), how perceptions were assessed, explanation/information in support of the 'perception' of varietal adoption provided by the panel, description of varieties on the adoption perception schedule (i.e., second database) that were not on the release list (i.e., first database), magnitude and reasons for any revisions to expert opinion, and confidence in the expert estimates of both MV as a group and for each variety individually) for each priority sub-region by season combination.
b. Record the data in an Excel spreadsheet using a database format with descriptors listed in columns and varieties listed as rows. The minimum data to be recorded in this excel database include: (A) country, (B) crop, (C) sub-region, (D) agricultural year, (E) name of the season (and months), (F) total harvested area, (G) name of the variety, (H) adoption estimate (as a proportion of total harvested area in column F), name of the person and affiliation who conducted the expert panel interviews (i.e., the facilitator), (G) date and (H) place where expert panel interviews were collected, and (I) Any comments or observations to help understand the results (esp. related to step 3h). At the bottom of the table, put the source of the data on total harvested area for each country (and sub-region, if different then the country level source).
c. The Center/CRP for a given commodity will be responsible to complete and submit a final version of the consolidated adoption database (4b) accompanied by short country level reports (related to 4a) to MSU. As part of the broader MSU workplan and responsibility for the SIAC project's objective 2.1, MSU will conduct and oversee a random 'audit' of the process used to assemble the adoption database covering 5-10% of the CCCs.

This step-wise process described above will hopefully serve as a guideline in planning and implementing this activity, and to ensure consistency and comparability of estimates across CCCs. Through trial and error, we expect some NARS/Center participants will arrive at an expert elicitation assessment process that is superior to this one in terms of cost-effectiveness and precision. Similar to the DIIVA and TRIVSA project, we don't consider a mailed questionnaire or convening a panel through a Skype conference call would be a suitable vehicle to generate reliable information. **An expert panel needs to be convened physically and the adoption estimates need to be generated through personal interactions, discussion, and group elicitation method.** This does not mean that the Center/CRP representative needs to be present in every panel meeting in all sub-regions in every priority country, but can certainly participate in some meetings, based on budget availability.

3.3.2 Variation of method 1: Conducting small scale representative field survey as an input in estimating nationally representative varietal adoption based on expert opinion

One of the greatest challenges of using the expert elicitation method is that experts often express their discomfort with assigning a percentage figure to variety-specific adoption rate. This is reflected in the low level of confidence they themselves may place on their estimates. A hypothesis is that increasing the knowledge and information base by providing supplementary data can help increase the level of comfort and confidence of the expert in this process, and thus the accuracy of their estimates. Steps 1b and 3b noted above in Method 1 are designed to serve this purpose. However, if time and resource permits, we recommend investing concerted efforts to strengthen these two steps (1b and 3b) in the form of generating a credible evidence base on which the whole expert elicitation process can be built. This will especially be conducive in CCCs where there is not much information base from prior studies on varietal adoption to build on. So as a variation of Method 1, we suggest following modifications in steps 1b and 3b in the overall description of method 1.

Modified Step 1b: To generate some evidence base on the status of varietal adoption that can serve as an input in the expert elicitation process, conduct a small-scale field based data collection effort in a sub-set of geographic

sub-regions. One or all of the following criteria can be used to select a geographic region for such data collection effort.

a. Importance of the crop (it is widely grown)
b. A region where there has been concerted and publicized efforts (by the government, NGOs, private sector) to disseminate seeds of improved varieties in the past
c. A region which can is considered 'representative' of the crop growing conditions in the country

The region could be a district or one of the sub-regions identified in step 2b. The idea is to select a geographic area that is not overwhelmingly 'big' and can provide evidence of varietal adoption that can be used as a benchmark to elicit expert opinion on estimates of adoption in other sub-regions to derive a nationally representative adoption data.

This field level data collection should be based on a sampling method that will provide a representative estimate of varietal adoption in that selected geographic region. Data and assistance from the national statistical office must be sought in coming up with the appropriate sampling frame and primary sampling units to be able to draw a probability based sample for data collection.

Possible options for field based method that can be used in this process include: 1) farmer level surveys to elicit names of varieties he/she planted on all the fields in the last completed agricultural year); or 2) community level surveys using focus groups to elicit information on percentage of farmers using different varieties. The second method requires some additional data collection or assumptions need to be made to translate such data into adoption rate expressed as percentage of area harvested. Note that the data collection method should take in to account the scope and definition of 'improved varieties' discussed in Section 3.2.

The actual nature of the field data collection may vary depending on available resources, but must be guided by the following principles of 'quick and clean' method:

a. The survey instrument should be short and to the point (i.e., focused on collecting information that will help estimate variety specific adoption rate)
b. The data collection effort (inclusive of data entry and analysis that will feed into step 3b) should be completed in a reasonable time frame (i.e., not more than one month)

Modified Step 3b: Explain the purpose of this activity and define what is considered an 'improved variety' (see section 3.2). Share the results of the adoption survey conducted in step 1b and explain the purpose, which is to generate adoption estimates that are representative of the selected area, and to use them as benchmarks against which estimates for other regions should be derived. Explain the characteristics of this sub-region that will help inform the elicitation process for other sub-regions. For example, does the characteristics of the sub-region make it more or less comparable to other regions? Do the results represent an upper or lower bound estimates of the overall and variety specific adoption rates?

3.3.3 Method 3: Estimating varietal adoption based on seed sales data

In CCCs where the following conducive factors exist, estimating varietal adoption based on seed sales data offers a viable and rigorous method.

a. A majority of farmers using improved varieties are using hybrid seeds
b. There is a formal and mature seed industry
c. Farmers rely on formal seed system for a large portion of their seed needs and there is a culture of purchasing fresh seeds or planting materials periodically

The steps to be involved in using this method include:

1. Collecting information on the seed sector; identifying major players along the seed value chain
2. Developing a strategy to collect seed sales data from ALL the entities involved in selling/distributing seeds to the final users. This will include developing a standard data collection tool, defining the time period of seed sales data, identifying the right people to approach.

3. Collecting the data by seed sales by varieties by season, and if appropriate by target regions for at least one year, and some background information on typical planting rates used by farmers in the targeted farming system (if different) and frequency of seed purchase (i.e., seed recycling behavior).
4. Converting the seed sales data into area planted, using the background information from step 3.
5. Comparing the area planted to different varieties derived from step 4 with the total area planted to come up with an estimate of adoption rates by varieties in the most recent year.
6. Reporting the results: This should be based on the general guidelines discussed in step 4 under Method 1.

In CCCs where private sector is a major (or minor) player, collecting seed sales data by variety may pose a challenge. This may be one of the most deterrent factors in using this method for estimating variety specific adoption rates. Further, this method would only be valid for very specific cases, as explained above. Seed producer associations could be key sources of seed production data, as would be the government's seed certification agency.

3.3.4 Method 4: Estimating varietal adoption based on field surveys

This method refers to collecting data through nationally representative field surveys conducted either at the community level or farmer level. The guidelines for using this method are similar to what is described under 'modified step 1b' in section 3.3.2, except that it will be at a national scale and thus will be more time and resource intensive than the efforts described in section 3.3.2.

Estimates of adoption of variety specific improved varieties based on elicited responses from farmers in a nationally representative survey for a given crop is generally considered high on the ranking of methods that give 'accurate' estimates. Thus, if there are nationally representative farmer level surveys that are routinely conducted (e.g., cost of cultivation surveys), then the cost of collecting adoption data as part of those surveys is marginal and may offer an affordable option to pursue for SIAC objective 2.1. This will require coordination with (and buy-in from) the agencies/entities conducting such representative surveys. This method is however not free from limitations (as noted in Table 4).

4. Summing up

The empirical outputs for Activity 2.1 are the two data bases described above accompanied by their respective reports or supporting materials described in step 4a for the second database (i.e., report on how estimates on cultivar specific adoption were generated and general information on the seasons and agro-ecological regions, plus any additional comments/suggestions/issues faced during data collection (e.g., judgment of secondary data used/not used)). **As previously stated, it would be good if the Center participants could send to MSU the implementation plan and data base results for the first country undertaken so that feedback could be provided.**

It is expected that at the Center/CRP level, a descriptive report summarizing the analysis of data for their specific crops across all countries will be prepared as one of the outputs of this exercise. Examples of descriptive reports with analysis and dummy tables to guide the preparation of this report will be provided by MSU. The descriptive report presenting the results of varietal release and varietal adoption should be as interpretative as possible (and not just repeating the numbers in the tables). This type of insights on what the data represents can only be provided by the NARS/Center representatives and will be very valuable in the aggregated analysis across all CCCs to be conducted later by MSU.

As part of MSU's workplan, some validation of the perceived adoption estimates by the experts by using field level surveys (and other methods of validation such as DNA fingerprinting analysis) will be conducted in a few selected CCCs in 2015. The selection of these CCCs will be made jointly by MSU and SPIA, and relevant NARS/Center partners will be consulted in that process.

Table 1. Priority Crop-country-combinations (CCCs) identified for SIAC Project, Objective 2.1 (version: April 15, 2014; may not be final)

Country	Rice	Maize	Wheat	Barley	Ground-nut	Chick-pea	Pigeon pea	Lentil	Cassava	Potato	Sweet potato	ALL
Afghanistan			1									1
Bangladesh		1	1					1		1		4
Cambodia	1	1							1			3
China (# of provinces)	6	8	6		2				1	9	8	40
India (# of states)	4	8	6	4				4	2	6	3	37
Indonesia	1	1			1				1	1	1	6
Iran		1	1			1		1				4
Laos	1								1			2
Malaysia	1											1
Myanmar	1				1	1	1		1			5
Nepal		1	1					1		1		4
Pakistan	1	1	1			1				1		5
Papua New Guinea											1	1
Philippines	1	1							1		1	4
Thailand	1	1							1			3
Vietnam	1	1			1				1	1	1	6
Total	19	25	17	4	5	3	1	7	10	20	15	126

Table 2. Examples of a minimum data set on varietal release:

1. Bean varieties released in Honduras (selected releases for illustration purposes only). Reyes 2012.

No.	Variety Name	Year of release	Institutional source	Growing Habit	Genealogy
1	Briyo AM	2009	PIF/ CIAL/ NGOs	Bush type	EAP 9510-77 // EAP 9510-77 / Rojo de Seda
2	La Majada AF	2009	PIF/ CIAL/ NGOs	Bush type	EAP 9510-77 // EAP 9510-77 / Paraisito
3	Milagrito	2009	PIF/ CIAL/ NGOs	Bush type	Mass selection from landrace
4	Quebradeño	2009	PIF/ CIAL/ NGOs	Bush type	MD 3075 // MD 3075 / Cincuenteño
5	Cardenal	2007	PIF/ DICTA	Bush type	SRC 1-12-1-47 / Amadeus 77
6	Conan 33	2007	PIF/ CIAL/ NGOs	Bush type	EAP 9503 / RS3 // MD 2324 / MD 30-37 //// EAP 9503 / RS3 // A429 / K2 /// V8025 / XR 16492 // APN83 / CNC
7	Deorho	2007	PIF/ DICTA	Bush type	SRC 1-12-1 / MD 3075
8	Don Cristóbal	2007	PIF/ CIAL/ NGOs	Bush type	DOR 476 // XAN 155 / DOR 364

2. Barley varieties released in Ethiopia (selected releases for illustration purposes only). DIIVA Project.

No.	Variety Name	Year of release	Institutional source	Variety Attributes/ Pedigree	Role of NARS/ Centers/ other programs
1	7th EMBSN 19/98	2010	ICARDA	Long plant height and drought tolerant	Crossing and selection by ICARDA_Mexico
2	TILLA (EMBSN 14/98)	2007	ICARDA	Drought tolerant and tolerant to scald and netblotch	Crossing and selection by ICARDA_Mexico
3	AGEGNEHU (218950-08)	2007	ARARI /Sirinka	Tolerant to major barley leaf diseases (scald and netblotch) and adapted to north eastern low moisture area	Pure line selection from local landrace
4	GUTA (Acc. 3260-18)	2007	ORARI/Sinana	Early vigor and tolerant to shoot fly	Pure line selection from local landrace
5	GABULA (Acc. 231222/MS)	2007	SARI/Awassa	Tolerant to major barley leaf diseases (scald and netblotch)	Pure line selection from local landrace
6	Bentu (EMBSN 5th 2/95-3-3-3)	2006	ICARDA	Long plant height and drought tolerant	Crossing and selection by ICARDA_Mexico
7	Desta (EMBSN 5th 46/95-9-9-5)	2006	ICARDA	Long plant height and drought tolerant	Crossing and selection by ICARDA_Mexico
8	HB-1307 (EH-1700/F7.B1.63.70)	2006	EIAR/ICARDA	Lodging resistant, resistant to scald and netblotch with good biomass yield	EIAR Cross - Awra Gebs (N.Ethiopia) /IBON 93/91

3. Potato varieties released in Rwanda (selected releases for illustration purposes only). DIIVA Project.

No.	Variety Name	Year of release	Institutional source	Variety Attributes/ Pedigree	Role of NARS/ Centers/ other programs
1	Victoria	2000	CIP/Uganda	378493.15Xbk precoz	CIP cross, NARS selected
2	Ngunda	1992	CIP/Rwanda	378493.915 x BK Mex	CIP cross, NARS selected
3	Mizero	1992	CIP/Rwanda	BL-2.9 x R128-6	CIP cross, NARS selected
4	Gikungu	1992	CIP/Rwanda	382124.6 x India 1039	CIP cross, NARS selected
5	Mugogo	1992	CIP/Rwanda	378493.738 x BK Plaisted	CIP cross, NARS selected
6	Nderera	1992	CIP/Rwanda	378493.915 x BK Precoz	CIP cross, NARS selected
7	Kigega	1992	CIP/Rwanda	VHF-69.1 x BK Mex	CIP cross, NARS selected
8	Kirundo	1989	Rwanda/CIP	.	NARS cross, CIP progenitor
9	Turbo	1989	Holland	SM 69-17 x VE 74-45	Developed country clone, NARS released
10	Obelix	1989	Holland	OSTARA x RENSKA	Developed country clone, NARS released

Table 3. Potential data sources for compiling the varietal release data base

Descriptors	Potential data sources
Official name of the variety Year of 'formal' release Institutional source of the released material Genetic background or information on the parents/population of the released variety, type of material and varietal attributes	• National or state varietal release database (which may be available online or in published form) should be consulted first to start compiling the list with all the available descriptors. This can then be updated by consulting with the breeding programs (NARS, CG centers, universities, private sector) active in the country; • Publications (such as agronomy and plant breeding journals) • Past adoption and impact studies
Varietal release classification in terms of role/input of NARS/Centers/other research programs	• The breeder or institution releasing the material should be the main source of this information; • Scientists from the Centers and CRPs can also serve as a resource for filling the gaps for this descriptor; • Published records (e.g., past impact studies)
Yield estimates	• Breeder or institution releasing the material should be consulted to provide this information • Research reports or scientific publications (such as agronomy and plant breeding journals) • Any database that publishes experimental varietal trial data
Assessment of adoption life cycle	• Experts such as breeders, extension agents, government or NGO agencies and private sector involved in seed multiplication and dissemination efforts
Seed multiplication:	• Collecting data on these descriptors will require first understanding the seed production system for a given crop and country, and then consulting major players involved in the seed value chain. For example, • Data on breeder seed can be obtained from the breeder him/her-self or his/her institution; • For foundation and certified (or quality declared) seeds, potential players include: the national or state seed production agencies, non-governmental organizations, private seed companies, etc.
Use of modern molecular tools, participatory plant breeding or associated intellectual property rights	• Breeder or institution releasing the material • Published reports

Table 4: Pros and cons of different methods of estimating nationally representative varietal adoption

Method	Pros	Cons
Field level surveys - **Farmer level**	• Considered most 'rigorous' • Provides estimates based on 'observation' rather than 'perception'—thus considered more 'evidence based' • Provides opportunity to collect household level data and analysis to address research questions on determinants of adoption and impacts • Can provide representative data that allows making inferences about the population of interest	• Resource intensive (time, money and skill) • Requires careful planning (e.g., training of enumerators, logistics of conducting nationally representative survey) and sampling frame data prior to data collection; and supervision for data quality control • Eliciting the information from farmers may not provide the most 'accurate' varietal adoption rate, esp., when: - Varieties have local names and are not identifiable on the official list of varietal releases - Farmers cannot name or identify the varieties - Varieties may be misidentified • Difficult to periodically (e.g., each year) use this method to estimate adoption rates over time
- **Community level**	• Relatively more cost-effective then farmer level survey • Provides estimates based on 'observation' rather than 'perception'—thus considered more 'evidence based'	• Adoption rate as a percentage of area harvested may be more challenging to estimate from community level surveys • All the other constraints mentioned under farmer level survey
Seed sales data	• Low cost • Lends itself to periodic tracking and estimation of varietal adoption • Provides accurate estimates of adoption of different improved varieties for which seed is purchased periodically from the formal seed system	• Requires the following conditions which may be difficult to observe for most CCCs: - A mature seed industry - A majority of farmers relying on the formal seed system - Farmers using fresh seeds on a regular basis • Accessing data from private sector may be difficult (information may be proprietary or guarded from competition)
Expert elicitation	• Relatively easy to implement • Low cost • Can be used to periodically to update estimation of varietal adoption	• Not considered most reliable • Estimated values of adoption rates per variety generally have higher confidence intervals • Provides 'perception' of relative adoption of different varieties rather than accurate estimates • May be prone to personal biases of experts and interpretation of what is being asked; thus data may not be comparable across CCCs • Need to find good 'experts' to obtain the best estimates possible

Table 5. Example of a template to record varietal adoption data based on expert elicitation method

Expert-level Data Collection Instrument

(To be completed by each Expert)

A1. Name:_____ A2. Affiliation:_____

A3. Today's Date:_____

A4. Country:	A5. Crop:
A6. Sub-Region/agro-ecological domain:	A7a. Season: A7b. Year:

Note: The frame of reference for all the following questions is the crop, sub-region and season/year noted above.

B. Please provide your estimate of the relative importance of improved varieties vs. local landraces as measured by percentage area harvested:

Varietal type	% Area	E. Please provide a brief explanation in support of the estimates in B1 and B2 (*use a separate sheet if more space is required*)
Traditional/Local/Landraces	B1.	
Modern/Improved	B2.	
	100%	

C. Please list all the improved crop varieties (in descending rank order) you believe farmers are currently growing in this sub-region by season combination	D. Please share your perception of percentage share of area harvested devoted to each variety identified (*if the list is significantly more than 12 varieties, restrict to varieties occupying the top 95% of MV adoption area. Use your own judgment on when it makes sense to aggregate 'all other improved varieties'*)	E. Please provide a justification for the basis of your estimates of perceived adoption or a brief explanation in support of this perception (*use a separate sheet if more space is required*)
C1.	D1.	
C2.	D2.	
C3.	D3.	
C4.	D4.	
C5.	D5.	
C6.	D6.	
C7.	D7.	
C8.	D8.	
C9.	D9.	
C10.	D10.	
C11. Local/Traditional varieties	B2.	
	100%	

Table 5. Cont'd

Panel-Level Data Consolidation Form

(To be completed by the researcher conducting the expert elicitation)

PA1. Name of the Researcher conducting this Activity:_____

PA2. Affiliation:_____ PA3. Today's Date:_____

PA4. Country:	PA5. Crop:
PA6. Sub-Region/agro-ecological domain:	PA7a. Season: PA7b. Year:
P8. Number of panel members	

Note: The frame of reference for all the following questions is the crop, sub-region and season/year noted above.

PB. Please provide the consolidated estimate of the relative importance of improved varieties vs. local landraces as measured by percentage area harvested:

Varietal type	% Area
Traditional/Local/Landraces	PB1.
Modern/Improved	PB2.
Total	100%

(Use a pencil or create a spreadsheet—as finalizing this list may be an iterative process)

PC. Please list all the improved crop varieties (in descending rank order) that the panel believes farmers are currently growing in this sub-region by season combination	PD. Please record the consensus panel estimate of percentage share of area harvested devoted to each variety identified (*if the list is significantly more than 12 varieties, restrict to varieties occupying the top 95% of MV adoption area. Use your own judgment on when it makes sense to aggregate 'all other improved varieties'*)	PE. Please record any comments /concerns /level of confidence expressed by the panel on a given estimate
PC1.	PD1.	PE1.
PC2.	PD2.	PE2.
PC3.	PD3.	PE3.
PC4.	PD4.	PE4.
PC5.	PD5.	PE5.
PC6.	PD6.	PE6.
PC7.	PD7.	PE7.
PC8.	PD8.	PE8.
PC9.	PD9.	PE9.
PC10.	PD10.	PE10.
PC11	PD11	PE11
PC12.	PD12.	PE12.
PC13. All other improved varieties	PD13.	PE13.
PB2. Local/Traditional varieties	PB2.	PE16..
	100%	

Filename: Guidelines SIAC 2 1 Activity v7 4-25-14.docx
Directory: C:\Users\Krishnan\Documents
Template: C:\Users\Krishnan\AppData\Roaming\Microsoft\Templates\Normal.dotm
Title:
Subject:
Author: Mywish Maredia
Keywords:
Comments:
Creation Date: 25/04/2014 17:55:00
Change Number: 3
Last Saved On: 25/04/2014 18:36:00
Last Saved By: Mywish Maredia
Total Editing Time: 42 Minutes
Last Printed On: 03/06/2014 11:32:00
As of Last Complete Printing
Number of Pages: 21
Number of Words: 10,625 (approx.)
Number of Characters: 60,569 (approx.)