



Vital Signs Protocol  
Farm Field Soil Sampling and Processing  
Version 1.0  
March 2014

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## **ACKNOWLEDGEMENTS**

The Vital Signs team would like to thank Keith Shepherd for his discussions and sharing farm sampling protocols.

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## 1. INTRODUCTION

Soils will be sampled and analyzed from farm fields where the most common staple and cash crops of the region are grown. Topsoil (0 to 20 cm) will be sampled in a maximum of three agricultural fields per farm that have been identified through the Agricultural Management Survey. The location of the fields that will be sampled for soils will be determined based on the timing of the administration of the agricultural management survey and crop harvest measurements.

- If the survey is administered during crop harvest season, then the soil sample should be taken from the quadrat where the crop harvest measurement was taken (as described in the crop harvest protocol).
- If, however, this is not the case, then the fields from which soil will be sampled will be determined according to the following protocol.

### *1.1 Definitions of Key Technical Terms*

**Soil texture:** the amount of sand, silt and clay in the soil. Texture is important for determining many soil properties, including soil aggregation and structure, which influence water and air movement through the soil.

**Soil health:** an assessment of the soil chemical and physical conditions that determine the suitability for plant growth.

**Soil nutrients:** Plants require 16 nutrients for growth. The major ones (macronutrients) are nitrogen (N), phosphorus (P), sulfur (S), potassium (K), calcium (Ca), magnesium (Mg). In addition, there are many micronutrients that are required in small quantities. If any of these nutrients are at levels insufficient for the plant, then plant growth will be inhibited and yields will be reduced.

**Soil pH:** the reaction of a soil is measured by pH. Optimal pH for crop growth is between 5.5 and 7.5. Soils with a pH less than 5.5 are considered acidic due to the presence of exchangeable aluminium that affects root growth and the uptake of nutrients.

**Soil organic matter content:** a critical component of the soil that determines the nutrient supplying and storage capacity. Soil organic matter influences the aggregation of smaller particles and the structure of soil, which in turn determines the movement and storage of water in the soil. The structure of the soil is also important for protecting the soil from erosion.

## 1.2 Standard Conventions Used in this Document

The following conventions are used throughout this document:

- The use of bold in the text indicates a critical point. Please pay special attention to terms, sentences and paragraphs marked in bold as they are key to the understanding of the protocol.

## 2. ROLES AND RESPONSIBILITIES

The following table introduces the roles and responsibilities of the members of a Vital Signs field team:

### Country Director

- Supports team with a complete understanding of the protocol manual
- Trains technicians
- Leads technicians in fieldwork and sampling, and assists with measurements as required

### Technical Manager

- Supervises teams
- Ensures equipment is well-managed and team is safe
- Ensures consistency and quality of measurements
- Ensures data are uploaded to the VS server daily (or weekly if internet access is limited)
- Ensures back-ups and data entry sheets are properly archived

### Enumerators

- Conduct interviews
- Perform soil sampling in fields
- Enter and uploads data
- Clean and store equipment

### Africa Field Director

- Helps train technicians and ensure consistency of protocol implementation across Vital Signs countries
- Reviews data when uploaded
- Approves protocol updates and sends out update notifications to field teams

### Protocol Manager

- Receives and archives comments about the protocol from the field team
- Updates and re-circulates the protocol

### 3. EQUIPMENT LIST

The following equipment is required to carry out the activities described in this manual. Before traveling to the field to carry out sampling, use this list to ensure you have all the equipment needed for the day.

If a tablet is been used to record data, at least one on-site backup to a laptop and, preferably, at least one off-site backup should be made at the end of each day.

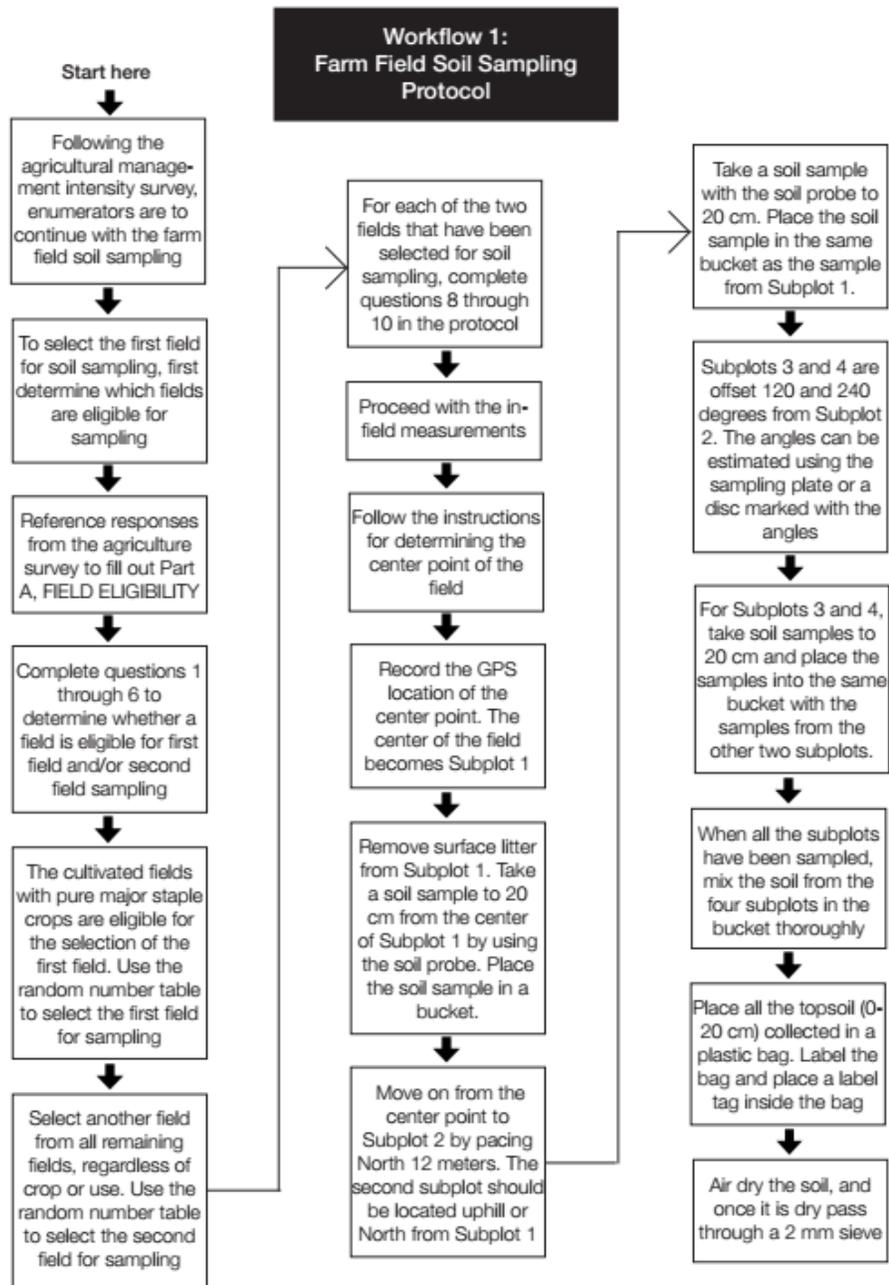
Each interviewer should have the following on their person:

- Identity card
- Letter of introduction
- Instructional book/manual (for interviewer and for questionnaire)
- Paper Questionnaire
- Tablet with form downloaded
- Pencil, rubber eraser, and sharpener
- Writing board and notebook
- Compass
- Sampling plate (optional, as long as there is other means for estimating the 120o angle between subplots)
- Soil probe (sufficient to sample to 20 cm depth)

### 4. FIELD SELECTION

Two fields per household will be selected randomly.

- The first field will be selected from one of the top three staple crops grown in the location, and only if that field is a pure monoculture of that crop as identified in the Agricultural Management Survey (see Table 1).
- The second field will be selected from all remaining agricultural fields. If the household does not have any pure, monoculture major staple crop fields, then the two fields will be selected randomly from the full list of agricultural fields identified in the Agricultural Management Survey.



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- Note that only fields larger than 10 m x 10 m should be eligible for sampling soils.

### *4.1 Selection of Major Staple Crop Field for Soil Sampling*

To select the first field for soil sampling, the enumerator must first determine which fields are to be sampled. This is accomplished by completing Section 13: SOIL DATA ENTRY, Part A, FIELD ELIGIBILITY. This should occur after the agricultural survey, and does not require the participation of any household respondent.

The enumerator should reference responses from the agriculture survey to fill out Part A, FIELD ELIGIBILITY. Match each field ID in Section 13 to each field ID from Section 2, FIELD ROSTER (from the agriculture survey).

*Question 1: Is this field size larger than 100 m<sup>2</sup>? (or 0.025 acres)*

The enumerator determines if the field is larger than 100 m<sup>2</sup> (0.025 acres). The enumerator should reference the agriculture survey, Section 2, FIELD ROSTER, Question 3, AREA (ACRES) FARMER'S ESTIMATE. If the field is larger than 0.025 acres, this question should be marked '1.' If not, it should be marked '2,' and the enumerator should move on to the NEXT FIELD.

*Question 2: Was the field cultivated during the current or most recently completed season?*

The definition for cultivated fields are the same definitions from the agriculture survey, Section 2, FIELD ROSTER, Question 2b1, "What was the use of this field during the Long Rainy Season/Major Cropping Season of 2013", and 2c, "What is the use of this field during the previous Short Rainy Season/Minor Cropping Season?" However, we are now asking about current activity on the field. If, at the time of survey, the farm is in between cultivation seasons (planting through harvesting), please reference the most recently completed season. If the field was CULTIVATED, this question should be marked '1.' If not, it should be marked '2,' and the enumerator should skip to Question 6.

*Question 3: Was one of the 3 major crops [insert 3 major crops] grown on this field during the current or most recently completed season?*

The definitions for major crops are the same definitions from the agriculture survey, Section 2, FIELD ROSTER, question 2b2, "What was the main crop cultivated on this field during the Long Rainy Season/Major Cropping Season of 2013" and question 2d1, "What was the main crop cultivated on this field during the Short Rainy Season/Minor Cropping Season?" However, we are now asking about current

activity on the field. If, at the time of survey, the farm is in between cultivation seasons (planting through harvesting), please reference the most recently completed season. If the reported crop is one of the major crops, this question should be marked '1.' If not, it should be marked '2,' and the enumerator should skip to Question 6.

*Question 4: Is this field a pure stand/monoculture?*

The enumerator may reference the agriculture survey, Section 4, CROPS BY FIELD, Question 3, "Was cultivation intercropped?" as an initial guide for the question. If the reported crop is pure stand/ monoculture, this question should be marked '1.' If not, it should be marked '2,' and the enumerator should skip to Question 6.

*Question 5: Is this field eligible for testing for first field?*

The enumerator should refer back to the responses for questions 1-4. Mark '1' in question 5 if both:

- Question 1, 2, 3 and 4 are marked '1'

*Question 6: Is this field eligible for testing for second field?*

Mark '1' in Question 6 if question 1 has been marked '1.'

Question 7: Is this field selected for testing?

Recall that only two fields will be selected for testing. We will randomly select one field that is eligible from Question 5, and one field that is eligible from Question 6.

Selection of the first crop field for soil sampling

The cultivated selection fields with pure crop major field staple are marked with "1" (Question 5) and are eligible for the selection of the first field (major staple crop).

- In order to select the field you will need to have a random number table with you (provided by the supervisor, example in Annex I).

Reading left to right in the row of the random number table, keep moving to the right until you find a number that matches the field ID number of one of the eligible major staple crop fields (see the example of how to do this below). Cross out this number on the random number table and mark a '1' in Question 7 for the selected field.

Note: if there is only one major staple crop field in the household, select that field by default.

#### 4.2 Selection of Second Crop Field for Soil Sampling

Second, select another field from all remaining fields, regardless of crop or use. All these fields are marked with “1” (Question 6) and are eligible for selection as the second field.

On the same random number table, start again at the left hand side of the random number row, looking for the first number that matches the field ID number of any of the fields. Cross out the entire line on the random number table, and mark a ‘1’ in Question 7 for the selected field. You must not select the same field as the first selection.

If there is no pure major staple crop field in the household, select two random fields using the same method as described above.

Note: do not use the same number line for multiple households. After randomly selecting the second field, make sure to use the next line in the random number table for new households.

#### 4.3 Example Selection of a Field for Soil Sampling

The fields eligible for the first field selection are chosen from those that are larger than 100m<sup>2</sup> (Question 1), cultivated (Question 2), and have one or more of the three primary staple crops (Question 3).

In this case, let’s say that the crops for this location are maize, sorghum, and beans. In this example let’s say those crops for this location are maize, sorghum and beans. In this example these are fields with maize (code=11), sorghum (code=13) and beans (code=31) being the major staple crop fields. Next is to see if that crop is planted in monoculture (Question 4). In this case only fields M2 and M5 are eligible to be selected as the first field for soil sampling. Finally, we mark all the eligible first fields for selection (Question 5). Now to randomly select which field, follow the step below (see Section 13.A, FIELD ELIGIBILITY).

Use the random number table provided by the supervisor, starting with the first row. To select the major staple crop field, look for the first number in the random number table that matches the field ID number of the eligible fields. In this example, the only eligible fields are M2 and M5. The first number that matches is number 2 – this field will be selected for soil sampling.

9	7	1	3	6	2
---	---	---	---	---	---

Next, we select the second field for testing from all remaining fields, regardless of crop. We mark with "1" all the fields that are eligible for selection of the second field (q6). The field 2 is excluded since it was already selected as a major crop for testing. Looking at the random number table and starting again from left to right, # 7 is the first number that matches the field ID number of one of the fields.

9	7	1	3	6	<del>2</del>
---	---	---	---	---	--------------

Once the first and second fields have been randomly selected, we indicate them in q7. For the two selected fields, write the field ID in Section B.

FIELD ID	1 Is this field size larger than 100m <sup>2</sup> ? (or 0.025 acres)	2 Was the field cultivated or used as a fallow during the Current or most recently completed Season?	3 Was one of the 3 major crops - insert 3 major crops - grown on this field during the Current or most recently completed Season?	4 Is this field purestand/ monoculture?	5 Is this field eligible for testing for first field?	6 Is this field eligible for testing for second field?	7 Is this field selected for testing?
M1	1	1	1 (maize)	1	1	1	1
M2	2			2			
M3	1	1	1 (sorghum)	1	1	1	
M4	1	1	2 (tomatoes)	2		1	1
M5	1	2					

B.SOIL MEASUREMENTS															
FIELD ID	8 What is the slope of the field?	9 Are there visible signs of soil erosion (sheet, rill or gully)?	10 Is there any erosion control/water harvesting facility ?	11 What type of erosion control/water harvesting facility is on this field?	12 What is the surface condition?										
					Rooted Plants	Litter Cover	Downed Wood	Stone or Gravel	Dung	Disturbed Soil	Undisturbed, Bare & Porous Soil	Undisturbed, bare but sealed soil	Sodic Soil	Microfloral Crust	Termite Mound
M1															
M4															

EROSION CODES

TERRACES.....1  
 EROSION CONTROL BUNDS..2  
 GABIONS / SANDBAGS....3  
 VETIVER GRASS.....4

TREE BELTS.....5  
 WATER HARVEST BUNDS..6  
 DRAINAGE DITCHES....7  
 DAM.....8

**For each of the two fields that has been selected for soil sampling, after arriving at each field, ask the following questions that are practically derived from the soil condition questions for the E-plot sampling.**

**Question 8 - Slope**

Ask the respondent about the slope of the field. Is it flat, with moderate slope, or with steep slope?

Flat (<8%)

Moderate slope (8-22%)

Steep slope (>22%)

**Question 9 - Erosion**

Erosion refers to the loss of topsoil from rain, wind, animals or people. Indicate yes if all or some of the field is suffering from erosion.

**Question 10 - Erosion**

Are there visible signs of soil erosion (sheet, rill or gully). Soil erosion:

1 None

2 Slight

3 Moderate

4 Severe

Are there any methods to prevent erosion on the field?

**Question 11 - Erosion**

What is the main method used to protect the field from erosion and record the code.

**Question 12 Surface condition score (0-10)**

Rooted plants

Little cover

Downed wood  
Stone or gravel  
Dung  
Disturbed soil  
Undisturbed, bare & porous soil  
Undisturbed, bare but sealed soil  
Sodic soil  
Microfloral crust  
Termite mound

### In-field measurements

For ease of sampling, the soil samples will be taken near the center of the plot. Go the center of the plot .

Once the center point of the field has been reached, the location of the sample subplots will be offset randomly. The offset will be determined by 1) direction and 2) distance.

#### 1) Direction

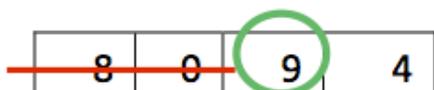
Using the random number table, select the first number. Use the direction lookup (Annex II) to match the number to a direction.



Note that if an 8 or 9 is selected, the enumerator should skip to the next number to find a direction match. Record the direction in SECTION C – SOIL SAMPLE OFFSET.

#### 2) Distance

Using the same line in the random number table, select the next number. This will be the number of paces to walk. Record the number of paces in SECTION C – SOIL SAMPLE OFFSET.



From the center of the field, walk to a new point in the field using the direction and number of paces. If a zero is selected, there is no need to walk any paces. If the edge of the field reached and you have not completed your pacing, simply turn around and complete the pacing back towards the center of the field. This point of the field becomes the center plot, and is referred to as subplot 1.

If the point turns out such that either of the conditions below hold – then offset the point to avoid these conditions.

- There are obstacles in that location such as trees, soil conservation structures, a rocky surface
- The point is not representative of the main part of the field. For example if a small section of the field, less than 10% appears to be prone to flooding, has slope significantly different from the other part of the field; has shallow or superficial rocky layer such as laterite that is not found in the rest of the field

**MAKE SURE THE SAMPLING POINT IS AT LEAST 2 M FROM THE EDGE OF THE FIELD.** If it is not then move the point directly into the field, perpendicular to the field border to the 2 m limit.

Remove surface litter from subplot 1. Take a soil sample to 20 cm from the center of subplot 1 by using the soil probe.

Place the soil sample in a bucket.

- Record any auger depth restrictions encountered for each sub-plot the field (in cm), if present, In the note field

Next move on from the center point to subplot #2 by pacing 12 m (or using a measuring tape or a pre-marked chain, This second subplot should be located directly uphill from the center point (if there is no slope then move N from the center to indicate subplot 2).

Take a soil sample with the soil probe to 20cm.

Place the soil sample in the same bucket as the sample from subplot 1.

Subplots 3 and 4 are offset 120 and 240 degrees from subplot 2, respectively. The angles can be estimated using the sampling plate or a disc marked with the angles as indicated in Figure 1.

For each of the subplots 3 and 4, take a soil sample to 20 cm and place the sample into the same bucket holding the samples from the other two subplots.

**Note:** If one of the sub-plots falls outside of the agricultural field, place the sub-plot 2 m within the farm field boundary.

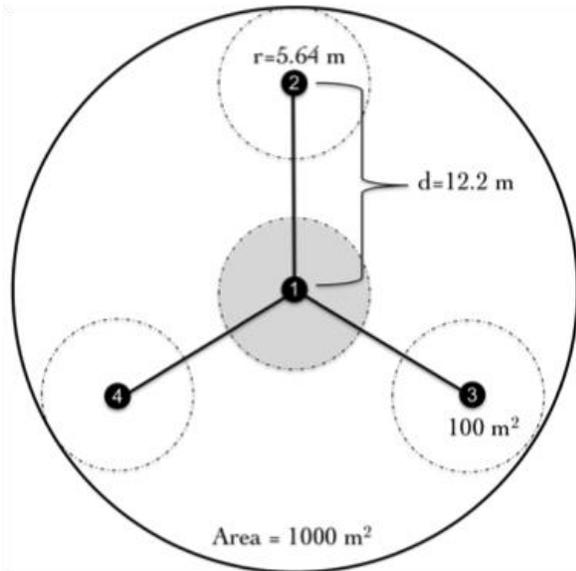


Figure 2. Sample plot layout in agricultural fields, with four subplots (dotted circles). Subplots have a radius of 5.64 m (area = 100 m<sup>2</sup>), and the distance along the radial arms between the subplot centers is 12.2 m. The whole plot has a radius of 17.84 m (area = 1000 m<sup>2</sup>). The angles can be measured using a compass or the sampling plate (Figure 1) can be placed over the center sampling point and marked and used to locate subplots 2, 3 and 4.

Note: It is possible that the quadrant is located near the edge or corner of the field refer to figure 3 for instructions on how to deal with this scenario.

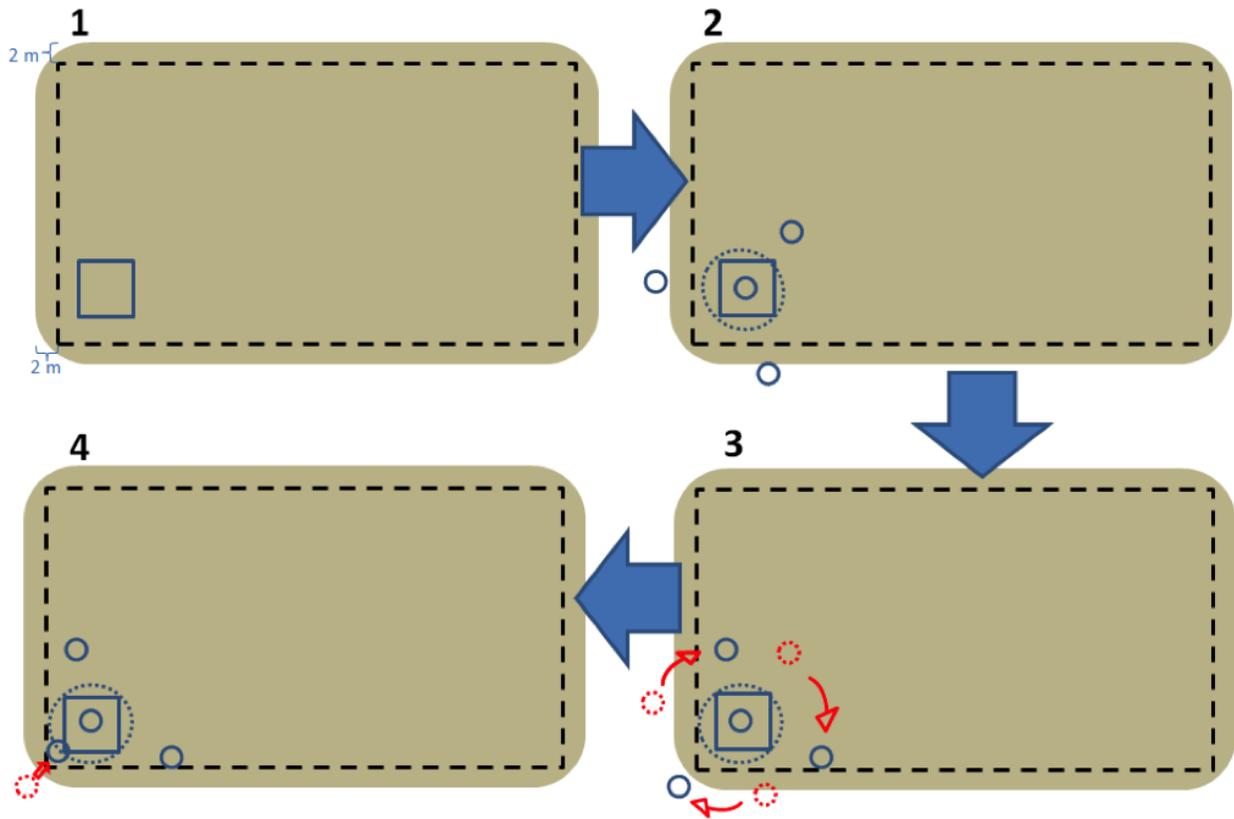


Figure 3. If the quadrant is close to the edge or corner of the field (1), either one or two of the subplots may be located outside the field AND outside the 2 meter buffer (2). Try first to rotate the orientation of the subplots (3) so that more subplots are located within the field and buffer. If a subplot is still outside of the field, move that subplot inside the 2 meter buffer of the field (4). This subplot will be closer to the center subplot than the other two, and may or may not be inside the quadrant.

When all subplots have been sampled, mix the soil from the four subplots in the bucket thoroughly.

Take a representative subsample of at least 400g of the soil from the top soil (0-20 cm) bucket and place it in a plastic bag. If there is less than 400g of soil, keep all of the soil. Label the bag. Place a label tag inside the bag.

**Label the bags with:** Site name/code; The full 10 digit HHID (inclusive of country, landscape, E-plot, and household IDs), field number, depth of sample, date of sampling, and 'FARM FIELD SOILS', as there are multiple types of soil collection. Note that the depth of sample will always be 0-20cm for the farmer fields.

Air dry the soil, once dried pass the soil through a 2 mm sieve and place approximately 400g soil in a plastic bag with a label on the inside and outside with the label code. Site name/code; HHID, field number, depth of sample, date of sampling

Note the depth of sample will always be 0-20cm for the farmer field samples.

Prepare the samples for shipping following the country specific instructions.

### ANNEX I: RANDOM TABLE NUMBER

	1 2 3 4	5 6 7 8	9 10 11 12	13 14 15 16	17 18 19 20	21 22 23 24	25 26 27 28	29 30 31 32
1	8 0 9 4	2 5 2 5	8 2 4 7	1 3 4 7	7 4 3 3	3 6 2 0	1 8 9 7	2 1 3 4
2	3 5 6 3	2 1 9 8	8 2 1 1	9 0 4 5	2 6 1 8	2 7 5 1	2 6 2 7	1 0 9 5
3	1 3 3 0	6 3 3 1	3 7 5 3	9 6 9 3	8 7 3 8	6 8 1 5	1 5 3 8	8 5 4 3
4	3 5 6 5	0 0 1 6	2 2 4 3	6 4 3 2	4 7 9 6	6 0 9 5	5 2 8 3	1 8 2 0
5	7 8 5 0	5 9 2 6	5 5 8 8	7 3 1 1	2 1 9 2	4 5 4 5	3 5 3 0	5 5 8 9
6	4 4 9 0	5 4 1 7	9 7 2 7	6 1 5 3	5 9 0 1	4 8 7 8	9 9 8 0	9 8 7 7
7	6 5 4 6	9 1 0 4	9 3 1 8	8 8 1 9	7 5 3 7	2 7 8 5	9 3 7 3	2 4 4 5
8	9 8 2 6	5 9 9 5	1 2 1 5	9 7 5 3	9 2 2 3	5 6 5 8	2 9 4 4	2 8 9 9
9	4 6 6 5	4 8 2 0	7 5 5 4	0 6 1 2	9 6 8 3	4 2 5 1	9 1 3 8	1 7 0 9
10	6 4 9 8	7 5 1 9	0 4 7 4	7 8 1 8	6 8 3 2	9 6 8 3	9 8 7 2	4 0 9 0
11	6 7 2 2	9 8 6 9	9 3 6 1	7 8 7 5	4 8 8 3	1 3 1 5	9 6 7 9	8 8 3 4
12	9 7 4 8	5 9 3 2	5 1 1 5	2 7 2 1	0 0 3 3	9 3 0 3	9 7 1 3	4 0 1 2
13	5 6 4 1	1 4 1 7	1 4 1 9	7 4 3 4	8 1 6 5	7 3 6 8	1 2 1 8	5 0 3 9
14	7 4 4 4	9 2 0 0	8 8 4 0	5 8 8 2	4 3 9 8	3 9 0 4	9 1 9 9	9 3 3 6
15	8 2 7 9	3 0 1 9	4 6 7 2	3 7 4 3	3 9 7 9	4 6 8 9	9 0 2 1	6 9 9 0
16	0 1 6 1	7 6 1 7	1 0 2 4	2 3 6 7	2 8 9 1	6 6 7 7	1 5 8 5	2 4 8 2
17	7 3 8 8	9 7 5 9	7 5 5 5	6 6 2 4	9 9 7 7	2 0 0 8	5 5 9 6	9 7 4 0
18	7 8 3 0	4 7 1 4	3 8 9 5	2 9 1 9	1 8 0 4	4 0 4 4	1 0 3 4	2 5 9 7
19	9 8 8 7	4 2 1 6	6 5 2 6	4 5 3 5	8 4 3 0	5 2 7 0	9 8 0 5	0 7 8 8
20	1 2 6 1	2 5 1 6	8 5 6 9	2 3 1 0	3 9 3 9	8 7 0 3	9 8 4 1	0 3 5 3
21	3 9 4 7	4 9 3 7	7 6 3 4	2 5 4 3	6 2 3 9	7 4 5 5	2 0 5 5	7 7 9 5
22	4 5 5 0	8 1 0 3	1 2 5 0	2 3 0 4	1 1 3 8	9 7 8 8	9 1 4 4	4 5 2 6
23	1 3 4 4	9 6 9 7	2 3 8 3	6 9 7 6	6 2 5 1	4 2 0 1	2 0 3 8	6 5 5 2
24	8 9 7 6	5 8 2 3	8 4 8 7	0 4 5 0	3 1 0 6	9 1 6 6	2 7 1 7	7 6 0 1
25	7 7 1 0	9 9 4 3	6 9 7 8	8 2 7 3	9 7 1 4	9 7 0 0	1 5 6 6	2 8 8 9
26	8 9 5 9	6 0 0 8	8 4 4 2	2 2 8 2	1 5 2 4	2 5 1 7	5 8 1 8	0 0 8 1
27	7 9 4 1	2 3 1 2	2 4 3 1	6 7 0 2	9 9 8 4	3 4 6 9	3 0 8 5	4 7 6 2
28	2 2 8 4	0 8 9 6	9 1 0 7	5 5 4 2	7 3 1 9	3 7 8 2	1 0 6 8	9 5 7 4
29	9 5 9 4	7 4 1 8	9 3 6 5	6 0 4 5	1 1 8 3	5 9 1 6	9 5 9 9	1 1 4 3
30	4 6 1 3	8 5 4 9	6 3 6 9	3 2 0 8	5 1 0 9	9 6 8 0	1 1 6 8	6 1 3 3

## ANNEX II: DIRECTION LOOKUP

0	N	5	SW
1	NE	6	W
2	E	7	NW
3	SE	8	SKIP TO NEXT NUMBER
4	SE	9	SKIP TO NEXT NUMBER