EASTERN PROVINCE-JURISDICTIONAL SUSTAINABLE LANDSCAPE PROJECT

STANDARD OPERATING PROCEDURES FOR AGRICULTURE

AUGUST 2023

BioCarbon Fund
Initiative for Sustainable Forest Landscapes

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About the Standard Operating Procedure (SOP)

Standard Operating Procedure			
Version	V1	**Date of Issue**	June 2023
Purpose	This SOP details how to set up and execute data collection for forest measurement and inventory approaches to assist in quantifying the amount of carbon within the various organic pools found within a eastern province landscape		
Responsibilities	MRV coordinator a) In coordination with the PIU, the role will entail working with agriculture sector lead officers to deliver high-quality MRV outputs. b) Will serve as a focal point for enquiries regarding national MRV systems. c) Will work closely with agriculture sector leads person, traditional leaders, community leaders, and private sector partners in developing and maintaining the MRV systems. d) Oversee data collection according to indicators and metrices provided for in the standard operating procedures for Agriculture. e) Provide guidance in the development of the sampling framework for Agriculture. f) Supervise data collection at district and chiefdom level for agriculture (crop and livestock).		
Prerequisites	Sampling design are provided in MRV management plan		
Related documents	The following are the related documents to be used alongside the SOP: a) MRV management plan b) ZIFLP-MRV mobile application software c) Integrated Land Use Assessment Phase II Zambia Biophysical Field Manual d) Forest Biophysical Field Data Entry Booklet Integrated Land Use Assessment Phase II Zambia		

ACRONYMNS

ATV	All Terrain Vehicle
EP-JSLP	Eastern Province –Jurisdiction Sustainable Landscape Project
GHG	Green House Gases
GPS	Global Positioning System
ILUA II	the Integrated Land Use Assessment
MRV	Measuring , Reporting and Verification
MRV	Monitoring Reporting and Verification
PIU	Project Implementation Unit
QA/QC	Quality Assurance and Quality Control
SOP	Standard Operating procedures
ZEMA	Zambia Environmental Management Agency
ZIFLPMRV	Zambia Integrated Forest Landscape Project – Measuring Reporting and Verification

1.0 INTRODUCTION

The Zambia Integrated Forest Landscape Project (ZIFLP) in Eastern province is supported by World Bank and its objective is to improve landscape management and increase environmental and economic benefits for targeted rural communities in the Eastern Province and to improve Zambia's capacity to respond promptly and effectively to an Eligible Crisis or Emergency.

The project provides support to rural communities in Eastern Province to allow them to better manage the resources of their landscapes so as to reduce deforestation and unsustainable agricultural expansion; enhance benefits they receive from forestry, agriculture and wildlife; and reduce their vulnerability to climate change. Simultaneously, the project is supporting the creation of the enabling environment for subsequent carbon emission reduction purchases. The ZIFLP's key beneficiaries are the rural poor communities of the Eastern province.

The Zambia Environmental Management Agency (ZEMA) with support from ZIFLP have been mandated to develop national and subnational (EP-JSLP) Measurement, Reporting and Verification System (MRV) and other GHG emission-related processes and systems under subcomponent 1.2: Emissions Reduction Framework. With this support, ZEMA will have one integrated and robust MRV that will be used to monitor emissions for the EP-JSLP and at national level.

The aim of this document is to provide standard field measurement approaches to assist in quantifying the amount of carbon in the various organic pools found within cropland in eastern province landscape. The documents also provides guidelines on measurements of livestock related, data. The methods presented in Standard Operating Procedure (SOP) is based on the Integrated Land Use Assessment (ILUA II) and good practices and lessons from drawn from regional and international experiences.

This SOP will be used in collaboration with the following:

e) MRV management plan
f) ZIFLP-MRV mobile application software

The SOPs are grouped by purpose. The first set of SOPs are general and can be used for many field measurement goals. A set of SOPs are also presented on the measurement of all the carbon pools for biomass, dead wood and litter, crop residues and soil carbon. These can be used to estimate the standing stock of a carbon pool within a stratum. This SOP along with the above mentioned documents should be used after receiving extensive field training in the measurement methods performed by a qualified forester or ecologist.

2.0 SOP FIELD SAFETY – LIVESTOCK/AGRICULTURE

No matter what activities are engaged in or where they are carried out, *safety is the first priority* and all precautions must be well thought out in advance and then strictly adhered to. Planned field activities must remain flexible and allow for adjustments in response to on-the-ground assessments of hazards and safety conditions. Accordingly, field personnel must be vigilant and always avoid unnecessary risks.

Field crew members must be well prepared. It is recommended that personnel engaging in field activities hold general first aid training and if possible, training in Cardiopulmonary Resuscitation (CPR).

The following guidelines will apply to all field-based activities:

- Mandatory buddy system. Field crews will include no less than two people who must be directly accompanying each other for the entire duration of field work. Ideally field crews should include a minimum of three people; in case of an accident resulting in injury one person may leave to seek help while another person stays with the injured crew member.
- For each day in the field, specific location and scheduling information must be logged in advance with a focal point person who can be reached at any time during the anticipated duration of field work. While in the field, crews should check in with their designated focal point person once per day.
- Each independent crew must carry a radio, satellite phone or cell phone provided by the institution. Crews should make sure to check batteries each time before entering the field. Power banks to be provided.
- Trip planning will include identification of the nearest medical facility and specific directions to reach that facility. When in areas with poisonous snakes, advance communication should be made to verify that appropriate antivenins are available. Where applicable, when operating in National Parks and Game Management Areas, regulations should be checked with local authorities e.g. Department of National and Wildlife (DNPW) prior to field work.
- Personnel will always carry personal and institutional insurance cards(such as NHIMA) with them. As well, personnel will carry identification and, if possible, institutional business cards at all times.
- Field crews will always carry a first aid kit with them. First aid kits should contain Epinephrin/Adrenalin or an antihistamine for allergic reactions (e.g., bee/wasp stings). Sun block and insect repellent should be carried in the field.
- Where poisonous snakes are common, snake chaps are recommended. In the event of snake bite, the victim should be taken immediately to a medical facility. Conventional “snake bite kits” (e.g., suction cups, razors) have been proven ineffective or even harmful and should not be used.
- Basic field clothing should be appropriate for the range of field conditions likely to be encountered. This will include: sturdy boots with good ankle support or rubber boots, long sleeves and pants, rain gear, and gloves. Blaze orange (vest or hat) is recommended when and where hunting may be taking place. Where

necessary, to avoid extended contact with plant oils, ticks, and/or chiggers, a change of clothes should be made at the end of each day in the field and field clothes should not be re worn without first laundering.

- Ensure personnel stay sufficiently hydrated and carry enough clean water for the intended activity. Carry iodine tablets or other water purification tablets in case there is a need to use water from an unpurified source. Can also carry chlorine for domestic use.
- Heightened caution should be given while operating any motor vehicle, particularly on off-roads where conditions are unreliable and rights-of-way are often not designated or adhered to. Motor bikes should always be operated at low speeds (<15 mph).
- Some plots may be too hazardous to sample. Situations include: plot center on a slope too steep to safely collect data (i.e., >100% slope or on a cliff); presence of bees; dangerous soils under peat lands; illegal activities; etc. When hazardous situations arise, a discussion should be conducted among the team members to assess the situation.

3.0 SOP LABELING PLOTS

The following provides recommendations on how plots in cropland (conventional, conservation, agro-forestry and pastures farming areas) should be labeled. However, this SOP must be altered and provide explicit instructions on how each plot will be labeled for a given field measurement campaign.

Proper plot labeling is important because it provides a unique signature to sampled plots as well as information about the sampling conducted. Experience has shown that plots should be named with multiple characters defining the type of sampling conducted, the area, the number of the plot and any other relevant information.

All plots must be numbered with a unique name and number. The labeling system must be finalized prior to data collection. The character denoting the number of the plot should include at least as many digits as total numbers of plots expected to be sampled. In other words, if the number of plots is expected to be greater than 100 but less than 1000, the number characters must be at least three integers e.g. 001 to 999.

The following is an example of a recommended plot labeling format: The coordinates of plot marker position are determined with the help of GPS receiver (as averaging positions of several measurements). Then, an identification code will be assigned to identify each points measured by the GPS as follows:

[Cluster number] + "P" + [Plot number] + "_M" (="Marker"), e.g. for cluster 113, plot 3 => 113P3_M

- A photo of the marker point may be taken, and it should show the same code;
- A steel marker pin should be positioned in the ground at the starting point of all plots.

Reference objects for starting point:

- Three prominent and preferably permanent reference objects (rock, non-abundant tree species or largest tree, house etc.) as fixed points must be identified for a marker.
- These objects should be 80-130 degrees apart to help with triangulation.
- The following information is recorded about the reference point: object ID, type of object, bearing (compass reading in degrees) to the plot marker, distance to the plot marker, tree diameter (if object is a tree), and photo ID.
- Reference point coordinates are only recorded if these cannot be measured at the plot marker point!
- A photo should be taken for each reference objects, and coded as follow:
    - [Cluster number] + "P" + [plot number] + "_R" + [running photo number within plot] (e.g. photo of the 3rd reference taken in the 2nd plot on the cluster number 28 28P2_R3

4.0 SOP DATA COLLECTION

The baseline crop samples must be collected from the project jurisdiction area (Eastern province). This process will cover farm plots within the targeted districts/chiefdoms throughout the province. The demographic, agricultural types (conventional, conservation, and agro-forestry), type of crops cultivated and socio-economic characteristics of the target areas will be identified and a detailed questionnaire provided on the mobile MRV application must be completed for every farm sampled. The questionnaire is embedded in the mobile MRV application.

Farm owners will be asked a number of questions pertaining the kind of agricultural practices currently in use (this will include the fertilizers or manures, seed types, type of tillage among others). The type of questions asked will also hinge on determining whether or not the farming practices and soil types are contributing to GHG emissions or removals. Details of the SOP for data collection are provided in the table 4.1.

Table 4.1 Standard operating procedure for agriculture

Procedure	
Step 1: Planning the data collection	**Step 1a** Identify data to be collected. Provided below is the sampling framework and number of persons to be involved in data collection.

Sample size

Total number of farmers under conventional farming	588,325
Sample size for conventional farmers	384
Total Number of Farmers under Conservation farming	196,634
Sample size for farmers practicing conservation farming	384
Total number of farmers under agro-forestry	94,484
Sample size for farmers practicing agro-forestry	383
Confidence level	95%
Margin of Error (%)	5%

The table below provides the number of personnel needed to undertake data collection on crop related data

Table 7. Number of personnel for collecting crop and livestock related data

Number of farmers per district	83
Number of data collectors per district	4
Total number of enumerators	56
Supervisors/quality control/District supervisor	14
Total personnel per district	5
Total personnel for Eastern Province	70

	Step 1 b. The MRV Coordinator estimates the necessary level of effort for the data collection. **Step 1c.** The MRV Coordinator identifies the persons who may be involved in the data collection in line with the records in the MRV Management Plan. **Step 1d.** The data collection timeline to be followed is as stipulated in the MRV management plan. **Step 1 e.** The PIU will arrange logistics, including a safety kit, field clothing, tablets, GPS, weighing scales, notebooks, markers, paper tags, sellotape, paper bags/ khaki bags and other equipment. There would also be a short capacity-building training prior to the field work to equip the field teams with necessary skills to undertake the assignment. The PIU will also ensure that there is sufficient time for data collection, and remuneration arrangements.
Step 2: Identification of areas and households in the district for sampling	**Step 2a.** The MRV Coordinator compiles a list of areas in each district where the survey should be conducted. The areas should be identified and marked geographically on the Map. The labelling sample should include the following: 1. The name of the farm plot where the crop samples will be collected from 2. The size of the farm in hectares where the samples will be collected from 3. The name of the owner of the farm where the sample will be collected 4. The name of the crops or any vegetation within the sampling plot 5. The type of farming practiced in the area (i.e. conventional or conservation farming , pastures or agro-forestry) 6. The type of fertilizers or manure used 7. The type of trees used in case of agro-forestry 8. The part of the plant where the sample is to be collected
Step 3: Training and calibration	**Step 3a.** As a first step in the data collection, the MRV Coordinator and the Trainer organize and prepare a training event for the persons identified in sub-step 1c as data collectors. The training should cover the following topics as a minimum: a) The brief project background and purpose of the activity b) Sampling and instruments for data capture c) How to administer questionnaire d) How to collect GPS readings, e) How to use the Tablet and enter data on the MRV mobile Application f) How to conduct measurements of the size of sampling plots g) How to use measuring instruments h) Quality management practices **Step 3b.** The Trainer implements the training event following these basic

	principles: a) Conducive environment for active participation, where participants can share questions and opinions b) Encourage communication between the data collectors c) Record attendance of the collectors d) Assess the capacity of the data collectors at the end of the training and record the results. **Step 3c.** The MRV Coordinator and the Trainer prepare a report summarizing the training actions taken, the attendance and the results of the assessment of capacity.
Step 4: Distribute the sample units among Data Collectors	**Sub-Step 4a.** The MRV Coordinator in collaboration with MRV Agriculture Sector Lead and MRV provincial sector leader decides on sample units to be assessed. **Sub-Step 4b.** The MRV Coordinator allocates sample units to data collectors in each district. The MRV Coordinator uses a list of locations in each district to distribute the samples to the collectors. **Sub-Step 4c.** The Coordinator records the number of sample areas, the Data Collectors assigned to assess those areas.
Step 5: Data collection	**Step 5ai.** Identify the community leaders and ask them to identify and choose randomly farm plots for conservation farming, agro-forestry, pastures and conventional farming that meets the criteria described in Step 2a above. **Step5aii** contact the farmers earmarked to participate in the sampling **Step 5bi.** Explain to farm owners the purpose of the sampling exercise and arrange to collect the samples from their farms. Ensure that farmers are well aware of the importance of adopting sustainable and environmentally friendly farming practices. Data collectors to take note and record the type of fertilizers used, type of crops cultivated, compare crop yield between farmers practicing conventional and conservation farming, type of plant diseases that affect the crops, type of agrochemicals used and other general agricultural practices that have been used by the respective farmers. **Step 5ci.** Record the size of the entire farm in hectarage and the type of crop the farmer cultivates. For each of the selected farm plots conduct the following activities: a) Record the type of vegetation surrounding the sampling plot other than the actual crop b) Record the type of tillage practice employed on a cultivated area **Sub-Step 5bii.** During the data collection, the district MRV supervisor, organizes random checks on the data collectors in the field to ensure quality control.

Sub-Step 5cii. The district MRV supervisor conducts random checks and notes challenges and limitations during the data collection as well as potential sources of bias during the data collection.

Step 6: Biomass from Agro-forestry

Step 6.1 Find and identify tree species used for agro-forestry
Step 6.2: measure the cultivated area
Step 6.3: Determine the number of trees per hectare
Step 6.4 Determine the Tree height

Record the readings in the table below accordingly.

	Farm ID	Agro-forestry Tree species name	Area cultivated (ha)- Measure using GPS	Number of trees per hectare	Diameter at Breast Height (DBH) (cm)	Ratio of below-ground to above ground	Age of the trees	Tree height (m)
1								
2								
3								
4								
5								

Step 7: Crop production

Step 1 Measure using GPS or tablet the total crop area of the farm
Step 2: Ask the farmer the Crop(s) grown in the season under review by name

Step 2: Ask the farmer the Quantity of each crop harvested (dry matter) tonnes (overall yield) under each of the agriculture practice

	Farm ID	Type of agriculture practice	Area cultivated (ha)- Measure using GPS	Crop yield number of bags	Average mass of a bag(kg)	Crop type	Area burnt of crop residues- Measure suing GPS
1		Improved reduced tillage (IRT)					
2		Conservation Tillage (CT)					
3		Conservation Farming (CF)					
4		Conventional					
5		Agroforestry					

Note: Estimate total number of bags harvested and Weigh at least five bags using a pallet scale

Key Definitions

DEFINATION	NON-NEGOCIABLES
Improved Reduced Tillage (IRT)	• Farmer clears the field and burns the crop residues • Correctly spaced permanent planting basins/rip lines prepared be • Early planting of all crops • Early weeding
Conservation Tillage (CT)	• No burning of residues • Correctly spaced permanent planting basins/rip lines prepared be • Early planting of all crops • Early weeding
Conservation Farming (CF)	• No burning of residues • Correctly spaced permanent planting basins/rip lines prepared be • Early planting of all crops • Early weeding • Rotation with a minimum of 30% legumes in the system
Conservation Agriculture (CA)	• No burning of residues • Correctly spaced permanent planting basins/rip lines prepared be • Early planting of all crops • Early weeding • Rotation with a minimum of 30% legumes in the system • Planting of Agro forestry trees

Step 8: Crop residues

Step 2: Crop residue biomass quantity estimate

1. If necessary, remove all vegetation to allow crop residue to be collected.
2. Collect all crop residue inside the frame (1 meter by 1 meter). A knife can be used to cut pieces that fall on the border of the sampling frame. Place the residue on the plastic sheet or trap.
3. Weigh crop residue. Record the total weight of the crop residue within the clip plot.
4. If there is no residue within the clip plot area, the clip plots should *not* be moved. Instead, the residue shall be recorded on the data sheet as 'zero'.
5. Take a sub-sample of residue. This should be a subset of the total sample and shall be made up of a mix of residue types found within the total sample. Place the subsample temporarily in a sample bag.
6. Repeat steps 1-6 for the remaining three locations.
7. Combine all four sub-samples into one subsample bag.
    a. Weigh the empty subsample bag empty. Record weight.
    b. Combine the subsamples from all 4 subplots into one subsample bag.
    c. Weigh the subsample bag with the subsample inside. The weight should be between 100- 300 g. Record the actual weight.
    d. Label the subsample bag with the plot identification number, subsample identification number, and weight of subsample.
    e. Take the subsample bag and subsample from field. Bring to the laboratory and dry the subsample. Reweigh the subsample. This subsample will be used to create a wet-to-dry ratio. This ratio will then be used to estimate the total dry weight of

	residue found within the clip plot. 8. Where plots are grouped in Clusters, it is allowable for samples from all four plots to be combined into one subsample. 9. It is allowable for there to be a delay between field data collection and laboratory analysis. However, sample bags must be placed in a location that allows air drying to occur. **Step 3:** Ask the farmer how crop residue has been used a) crop residues, returned to soils b) part used for animal feed c) part burnt. (Estimate area burnt) **d)** Part used as fuel for heating
Step 9: Fertilisers	**Step 1:** Ask the farmer on the amount/quantity of synthetic fertiliser used per hectare, type of crop planted, Type of fertiliser, and lime applied under each of the agriculture practice and filling the table following table

	Type of agriculture Practice	Area cultivated	Crop planted	Quantity of D compound applied		Quantity of Urea Applied		Quantity of compost applied (kg)	Quantity of manure applied (kg)	Quantity of lime applied (kg)
				Number of Bags	Weight of Bags(kg)	Number of bags	Weight of the bags(kg)			
1	**Improved Reduced Tillage (IRT)**									
2	**Conservation Tillage (CT)**									
3	**Conservation Farming (CF)**									
4	**Conservation Agriculture (CA)**									

Step 10: Rice Cultivation	**Step 1:** Ask the farmer Cultivation period and harvested areas for rice under the following and fill in the following table accordingly:

	Rice cultivation practice	Harvested Area(ha)-Measure with GPS	Cultivation Period for rice (Days)
1	Upland rice		
2	Irrigated rice		
3	Rainfed		

Step 11: Soils	**Step 10.1 Assess soil carbon for Minerals Soils** Step 10.1 Remove all vegetation and litter from the sampling

location. Because the carbon concentration of organic materials is much higher than that of the mineral soil, including even a small amount of surface material can result in a serious overestimation of soil carbon stocks.

Step 10.2 There are two options for sampling the soil: using a standard soil corer (option 1) or digging a small pit (option 2). Sampling forest soils with a standard soil corer can often present difficulties as the corer can hit roots frequently, which makes it difficult to extract a full core.

Step 10.3: Option 1 – Soil corer method

a. Insert the soil corer/probe steadily to standard depth of 30 cm.
b. If the soil is compacted, use a rubber mallet to fully insert. If the probe will not penetrate to the full depth, do not force it as it is likely that a stone/root is blocking its route and if forced the probe will be damaged. If blocked withdraw the probe, clean out any collected soil, and insert in a new location.
c. If depth of soil at sampling point is less than standard depth measured, then the depth of the soil sampled must be recorded.
d. Carefully extract the probe and put soil into a cloth bag. Assign bag a unique ID number.
e. To reduce variability, repeat steps a-d at a total of 4 points per sampling location / tree plot.
f. Mix all four samples thoroughly to a uniform color and consistency. It is important to take special care to remove pieces of litter and charcoal from samples at any sites
g. Place one thoroughly mixed subsample into a labeled sample bag. Ensure total weight of soil in bag is greater than the minimum soil weight required by the soil laboratory (if soil is very wet, this should be taken into consideration in determining mass of soil contained in soil sample bag).
h. For each sampling plot, take an additional two cores for determination of bulk density. When taking cores for measurements of bulk density, care should be taken to avoid any loss of soil from the cores.
i. Therefore, each sampling plot (e.g. tree plot) will have three soil samples: 1 bag for soil carbon estimation, 2 bags for bulk density estimation.

2. Option 2- Soil pit method

   Four small pits, one at each of the four sampling locations, will be dug and aggregated into one sample.

   a. Dig a soil pit 30 cm deep, making sure that one of the walls is perpendicular to the soil surface. A folding entrenching shovel (military type, with a flat shovel) is usually light and versatile for digging the pit, however any digging instrument can be used.

b. Using the shovel take a slice of soil from one of the walls of the soil pit. The slice should be uniform throughout the 30 cm profile, i.e. an equal amount of soil should be collected from the first 15 cm as the last 15 cm. Soil carbon usually decreases with depth, and if the slice collected contains more soil from the top of the pit versus the bottom the soil carbon estimate will be biased.
c. Repeat steps a-c at the other 3 sampling locations.
d. Mix all four samples thoroughly to a uniform color and consistency. It is important to take special care to remove pieces of litter and charcoal from samples at any sites.
e. Place one thoroughly mixed subsample into a labeled sample bag. Ensure total weight of soil in bag is greater than the minimum soil weight required by the soil laboratory (if soil is very wet, this should be taken into consideration in determining mass or soil contained in soil sample bag).
f. For each sampling plot, two estimates of bulk density shall be taken using a bulk density ring. This should take place at 2 out of the 4 sampling locations.
   i. After removing the soil for carbon measurements, place the bulk density ring over the mid-point of the soil pit. This would normally be at 15 cm.

Cover the ring with a piece of wood and hammer the ring into the side of the soil pit (avoid compacting the soil).

   i. When the ring is flush with the side of the soil pit dig around the ring until the soil ring can be removed along with all the soil inside. If soil falls out of the ring, the process must be repeated.
   ii. Carefully place the soil contained in the bulk density ring into a sample bag and label

j. Therefore, each sampling plot (e.g. tree plot) will have three soil samples: 1 bag for soil carbon estimation, 2 bags for bulk density estimation.

3. It is allowable for there to be a delay between field data collection and laboratory analysis. However, sample bags must be placed in a location that allows air drying to occur. Promptly send soil samples to a professional lab for analysis

Step 10.4: Organic soils drained

a) Measure land area of drained organic soils for agriculture using GPS

	or tablet
Step 12: Livestock	**Step 1:** Ask the farmer the number of animals produced in the season under review for the following:

Animal type			Number of animals
Dairy cows	Feedlot animals fed with > 90%		
	Concentrate diet;		
	Pasture fed animals;		
	Animals fed – low quality forage		
	Lactating cows		
	Dairy bulls		
	Mature Dairy Cow	High-producing cows that have calved at least once and are used principally for milk production	
		Low-producing cows that have calved at least once and are used principally for milk production	
Other cattle	Feedlot animals fed with > 90%		
	Concentrate diet;		
	Bulls		
	non-lactating cows		
	Pasture fed animals;		
	Animals fed – low quality forage		
	Other Mature Cattle-Females	Cows used to produce offspring for meat	
		Cows used for more than one production purpose: milk, meat, draft	
	Other Mature Cattle-Males	Bulls used principally for breeding purposes	
		Bullocks used principally for draft power	
	Growing Cattle	Calves pre-weaning	

		Replacement dairy heifers	
		Growing / fattening cattle or buffalo post-weaning	
		Feedlot-fed cattle on diets containing > 90 % concentrates	
Sheep	Feedlot animals fed with > 90%		
	Concentrate diet;		
	Pasture fed animals;		
	Animals fed – low quality forage		
	Sheep (lamb to 1 year)		
	Sheep (older than 1 year)		
	Mature Ewes	Breeding ewes for production of offspring and wool production	
		Other Mature Sheep (>1 year)	
	Growing lambs	Intact males	
		Castrates	
		Females	
Goats	Feedlot animals fed with > 90%		
	Concentrate diet;		
	Pasture fed animals;		
	Animals fed – low quality forage		
Horses	Feedlot animals fed with > 90%		
	Concentrate diet;		
	Pasture fed animals;		
	Animals fed – low quality forage		
Donkeys	Feedlot animals fed with > 90%		
	Concentrate		

	diet;		
	Pasture fed animals;		
	Animals fed – low quality forage		
Rabbits			
Swines	Mature Swine – confinement		
	Growing Swine - confinement		
	Swine – free range		
	Mature Swine –	Sows in gestation	
		Sows which have farrowed and are nursing young	
		Boars that are used for breeding purposes	
	Growing Swine	Nursery	
		Finishing	
		Gilts that will be used for breeding purposes	
		Growing boars that will be used for breeding purposes	
Poultry	Turkeys – confinement		
	Geese – confinement		
	Chickens	Broiler chickens grown for producing meat	
		Layer chickens for producing eggs, where manure is managed in dry systems (e.g., high-rise houses	
		Layer chickens for producing eggs, where manure is managed in wet systems (e.g., lagoons)	
		Chickens under free-range conditions for egg or meat production	
		Broiler chickens grown for producing meat	

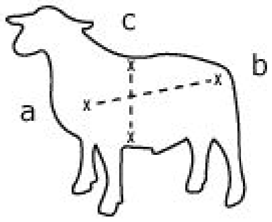
Step 2: Determine the weight of the animal

Step 2 a Sheep/Goat

Measure at least 5 animals and record readings

Record the age of the animal

Measure the circumference of the animal, as shown in distance C in the illustration. Make sure to measure girth in relation to the location of the animal's heart. On a sheep, ensure an accurate measurement by compressing the sheep's wool so that the circumference reflects that of the body and does not include that of the body plus the wool[1].



Measure the length of the animal's body, as shown in distance A-B in the illustration. From point of shoulder to pin bone.
Using the measurements from steps 1 and 2, calculate body weight using the formula HEART GIRTH x HEART GIRTH x BODY LENGTH / 300 = ANIMAL WEIGHT IN POUNDS.
For example, if a sheep has a heart girth equal to 35 inches and a body length equal to 30 inches, the calculation would be (35 x 35 x 30) / 300 = 122 lbs.

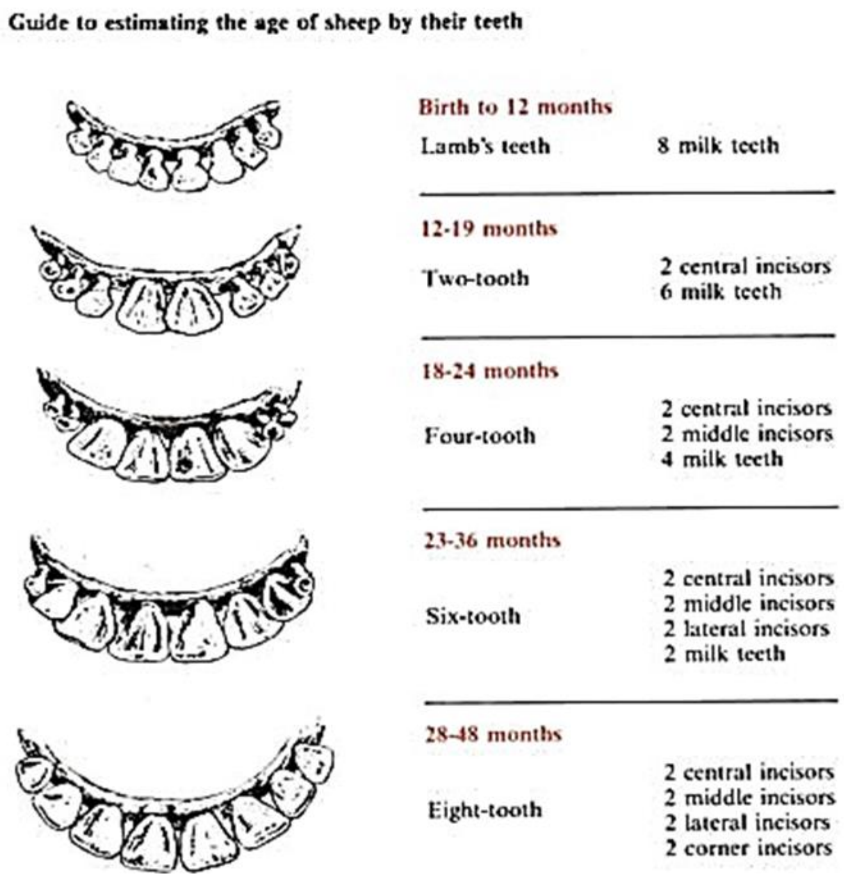
Record the readings on **sheep** in the table below:

	Animal length-L (a-b)	Animal circumference C(c)	Animal weight(W) in kg $W = \frac{C*C*L}{300*2.2046}$
Animal1			
Animal2			
Animal3			
Animal4			
Animal5			
Animal6			
Animal7			

Record the readings on **Goats** in the table below:

	Animal length-L (a-b)	Animal circumference C(c)	Animal weight(W) in kg $W = \frac{C*C*L}{300*2.2046}$
Animal1			
Animal2			
Animal3			
Animal4			
Animal5			
Animal6			
Animal7			

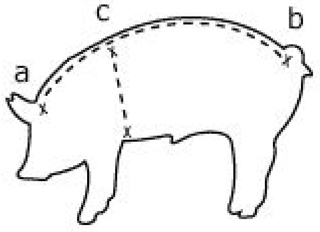
[1] https://extension.oregonstate.edu/sites/default/files/documents/51006/weightcalculator.pdf



Step 2 b Sheep/Goat

Measure at least 5 mature pigs.
Record the age of each pig to be measured

Measure the circumference of the animal, as shown in "distance C" in the illustration. Make sure to measure girth in relation to the location of the pig's heart. Measure the length of the animal's body, as shown in distance A-B in the illustration. The pig must be standing or restrained in the position shown in the illustration for the calculation to be nearly accurate. Using the measurements from steps 1 and 2, calculate body weight using the formula HEART GIRTH x HEART GIRTH x BODY LENGTH / 400 = ANIMAL WEIGHT IN POUNDS[2].



Measuring swine.

For example, if an adult pig has a heart girth

[2] https://extension.oregonstate.edu/sites/default/files/documents/51006/weightcalculator.pdf

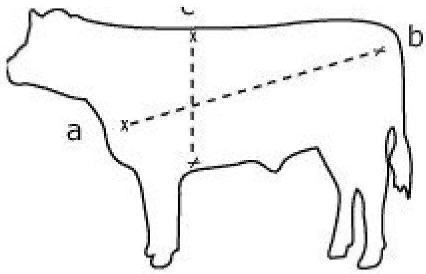
equal to 45 inches and a body length equal to 54 inches,
the calculation would be (45 x 45 x 54) / 400 = 273 lbs.
If the hog or sow weighs less than 150 lbs., add 7 lbs. to the final answer.

Record the readings on Swine/Pigs in the table below:

	Animal length- L (a-b)	Animal circumference C(c)	Animal weight(W) in kg $W = \frac{C*C*L}{300*2.2046}$
Animal1			
Animal2			
Animal3			
Animal4			
Animal5			
Animal6			
Animal7			

Step 2 b Cattle

Measure the circumference of the animal, as shown in "distance C" in the illustration. Make sure to measure girth in relation to the location of the animal's heart. Measure the length of the animal's body, as shown in distance A-B in the illustration[3].



Measuring beef cattle.

Using the measurements from steps 1 and 2, calculate body weight using the formula HEART GIRTH x HEART GIRTH x BODY LENGTH / 300 = ANIMAL WEIGHT IN POUNDS. For example, if a beef cow has a heart girth equal to 70 inches and a body length equal to 78 inches,
the calculation would be (70 x 70 x 78) / 300 = 1,274 lbs.

Record the readings on **Cattle** in the table below:

	Animal length- L (a-b)	Animal circumference C(c)	Animal weight(W) in kg $W = \frac{C*C*L}{300*2.2046}$
Animal1			
Animal2			

[3] https://extension.oregonstate.edu/sites/default/files/documents/51006/weightcalculator.pdf

Animal3			
Animal4			
Animal5			
Animal6			
Animal7			

Step 3: Ask the famer the following:

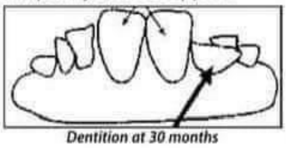
a) **Ask how animals are fed: confined, grazing, pasture conditions;**
b) **milk production per day (kg/day) of dairy cattle**
c) **Take milk samples to the laboratory for butterfat content testing**
d) **Percentage of cows pregnant**
e) **Number of female animals that give birth in a year/**
f) **(%) number of offspring in a season**
g) **Average Daily Weight gain (kg/day)**
h) **Take weight measurements of an animal 15 days apart..**

C. DETERMINING AGE OF AN ANIMAL

Determining age of the animal is important while purchasing a new animal since the information provided by the seller may not always be reliable.

I. DETERMINING AGE BY DENTITION

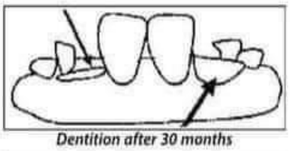
At birth to one month, two or more temporary incisor teeth are present. By first month all 8 temporary incisors appear.



Dentition at 30 months

The central pair of temporary incisors are replaced by permanent ones which attains full growth by 2 years (thin arrows).

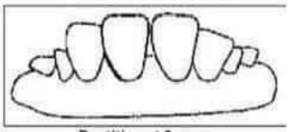
The third permanent incisor erupts at around 30 months of age (thick arrow)



Dentition after 30 months

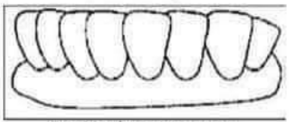
The fourth permanent incisors erupt after 30 months.

Dentition of a 3 year old cattle with 2 pairs of fully developed incisors



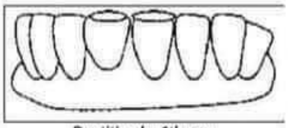
Dentition at 3 years

The second pair of incisors is fully developed at 3 years.



Dentition by 4-5 years years

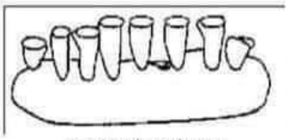
By the 4-5 years the animal has a full set of permanent incisors. (In buffaloes by 5-6 years)



Dentition by 6th year

By the sixth year, the central incisor shows wear and leveled top.

Dentition of cattle aged around 4-5 years with 4 pairs of permanent incisors.



Dentition by 10th year

The wearing progresses steadily after the sixth year and by the tenth year, all the incisors show significant wear and space in between them.

II. DETERMINING AGE BY HORN RINGS

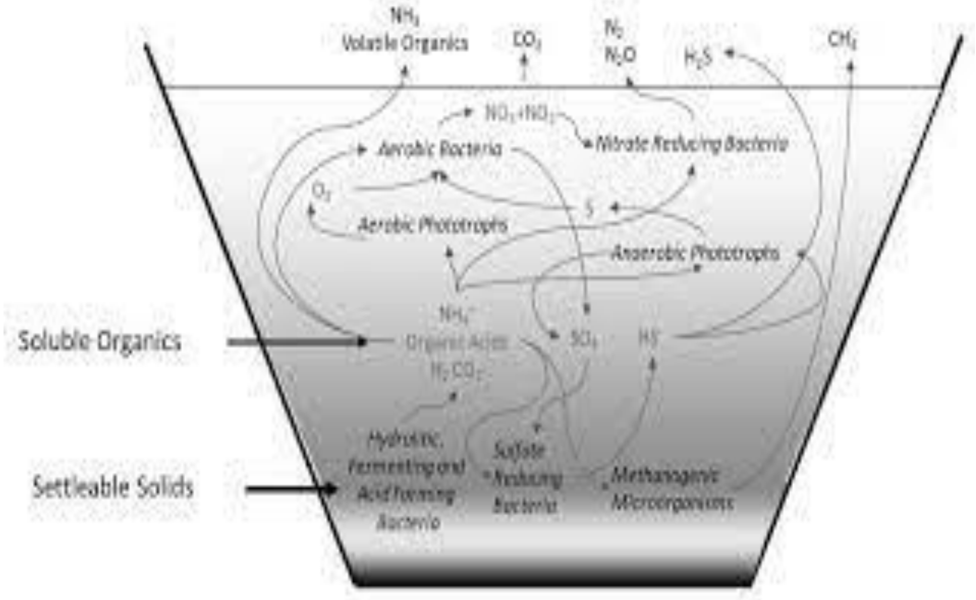
This is not a good guide and may give only a very rough idea. The first horn ring appears at 10-12 months. One ring is added approximately in a year. But at the fifth year, the first three rings may not be visible and after 8 years, none may be visible.

Step 4: Manure management :

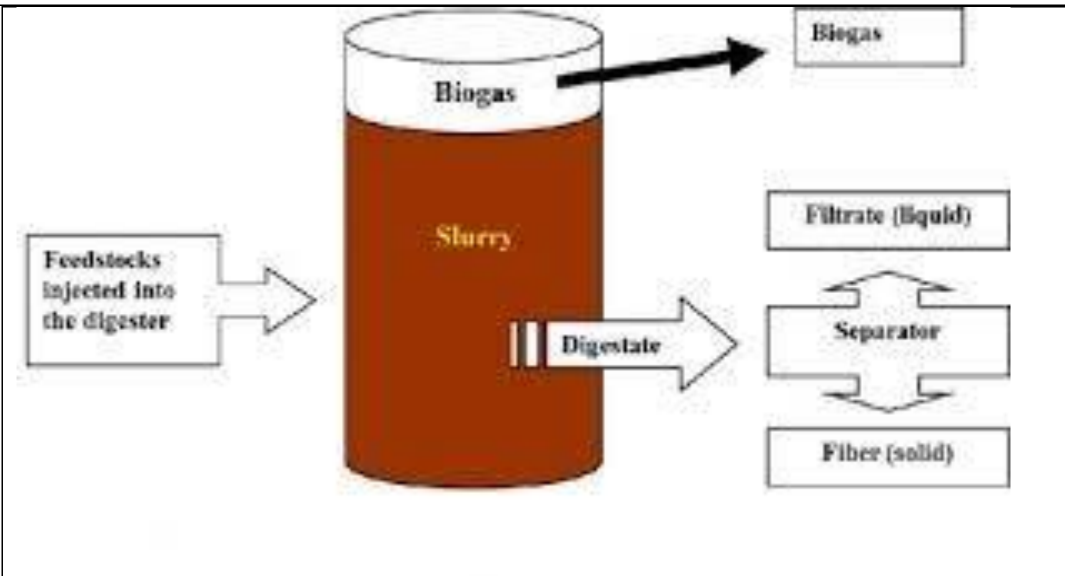
Ask the farmer the type of manure management system being practiced at the farm according to the definition provided in the following table.

System	Definition	Tick as appropriate
Pasture/ range/paddock	The manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed	
Daily Spread	Manure is routinely removed from a confinement facility and is applied to cropland or pasture within 24 hours of excretion.	
Solid storage	The storage of manure, typically for a period ,from the time it is stored to the time it is disposed of or utilised in unconfined piles or	

	stacks. Manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation.	
		
Dry lot	A paved or unpaved open confinement area without any significant vegetative cover (shade) where accumulating manure may be removed periodically. Dry lots are fenced areas that are bare of grass and key to rotational grazing systems. Dry lots should provide shelter, water, feed and at least 400 square feet per animal. In Zambia this is likened to a kraal	
		
Liquid/slurry	Manure is stored as excreted or with some minimal addition of water in either tanks or earthen	

	ponds outside the animal housing, usually for periods less than one year.	
Uncovered anaerobic lagoon	A type of liquid storage system designed and operated to combine waste stabilization and storage. Lagoon supernatant is usually used to remove manure from the associated confinement facilities to the lagoon. Anaerobic lagoons are designed with varying lengths of storage (up to a year or greater), depending on the climate region, the volatile solids loading rate, and other operational factors. The water from the lagoon may be recycled as flush water or used to irrigate and fertilise fields.	A small freshwater lake near a larger lake or river.
		
Pit storage below animal confinements	Collection and storage of manure usually with little or no added water typically below a slatted floor in an enclosed animal confinement facility, usually for periods less than one year.	
Anaerobic digester	Animal excreta with or without straw are collected and anaerobically digested in a large containment vessel or covered lagoon. Digesters are designed and operated for waste stabilization by the microbial reduction of complex organic compounds to CO2 and CH4, which is captured and flared or used as a fuel	
Burned for fuel	The dung and urine are excreted on fields. The sun dried dung cakes are burned for fuel.	
Cattle and Swine deep bedding	As manure accumulates, bedding is continually added to absorb moisture over a production cycle and possibly for as long as 6 to 12	

		months. This manure management system also is known as a bedded pack manure management system and may be combined with a dry lot or pasture	
	Composting - in-vessel[a]	Composting, typically in an enclosed channel, with forced aeration and continuous mixing.	
	Composting - Static pile	Composting in piles with forced aeration but no mixing	
	Composting - Intensive windrow	Composting in windrows with regular (at least daily) turning for mixing and aeration.	
	Composting - Passive windrow	Composting in windrows with infrequent turning for mixing and aeration.	
	Poultry manure with litter	Similar to cattle and swine deep bedding except usually not combined with a dry lot or pasture. Typically used for all poultry breeder flocks and for the production of meat type chickens (broilers) and other fowl.	
	Poultry manure without litter	May be similar to open pits in enclosed animal confinement facilities or may be designed and operated to dry the manure as it accumulates. The latter is known as a high-rise manure management system and is a form of passive windrow composting when designed and operated properly.	
	Aerobic treatment	The biological oxidation of manure collected as a liquid with either forced or natural aeration. Natural aeration is limited to aerobic and facultative ponds and wetland systems and is due primarily to photosynthesis. Hence, these systems typically become anoxic during periods without sunlight.	

	
Step 13: Data assembly	**Sub-Step 13a.** After the data collection is completed, the MRV Coordinator ensures data is well compiled and archived in readiness for analysis. **Sub-Step 13b.** The MRV Coordinator checks that all the necessary data and sample information is archived and included in the final database.
DOs AND DONTS'	a) Labelling must be done on site and not in advance b) Data collectors must indicate the start and end time once they get on site c) All data collection teams must be provided with the same number of equipment d) Firstaid kit is a MUST e) Data collectors must not use pens to label, rather Pencil must be used. This is so because writings in pencil do not dissolve if the soil is wet, ink on the other hand easily dissolves f) Crop samples must be stored in paper bags and never in plastic bags g) Data collectors must make sure they stick to the set steps and guidelines so that quality of the work is not compromised

5.0 SOP DATA ANALYSIS

This SOP provides for analysis of soil carbon, crop residues, crop production, fertiliers consumption, rice cultivation, uncertainty and confidence levels.

Step 1. Calculating soil carbon

Soil samples from each of the three depths are composted and well-mixed per sampling plot and then prepared for carbon measurement by removing stones and plant residue > 2mm as well as by grinding.

Step 1: Calculate soil bulk density

Soil bulk density (Db) is the soil mass (Ms) per unit of total volume (Vt):

$$Db = \frac{Ms}{Vt}$$

Ms refers to dried soil mass and Vt to the volume of solids and pore space. *Db* is reported as Mg m^{-3} or g cm^{-3}. Note that the sample unit volume represents the volume of the sample unit at the time of the original collection.

Coarse roots and mineral fragments (i.e. greater than 2 mm size) should be removed.[43] Soils with gravel and stones within the core would need a Db corrected for the gravel and stone fraction[44]:

$$Db = \frac{Ms}{Vt - [\frac{RF}{PD}]}$$

Where *RF* is the mass of coarse fragments and *PD* the density of rock fragments (a default of 2.65 g cm^{-3} can be assumed).

Record readings for each Sample Plot under different farming type(i.e. agro-forestry, conservation farming, conventional farming)

Sample plot ID	Depth (cm)	Total soil dry mass(g)	Mass of rock fragments(g)	Bulk density (g/cm^3)	Soil carbon content(%)	SOC (tonne/hectare)

	The carbon stock density of soil organic carbon is calculated as (Pearson *et al*., 2007): $$SOC = 100 * \rho * dp * \frac{C}{100}$$ Where: SOC = Soil organic carbon stock per unit area (t ha-1); ρ = soil bulk density [g cm-3]; dp = the total depth at which the sample was taken [cm]; and % = carbon concentration [%].

Procedures for calculating crop residuals are as follows:

Step 1.	Samples are taken destructively in the field within a small area of 0.25 m^2. Fresh samples are weighed in the field with a 0.1 gr precision; and a well-mixed sub-sample is then placed in a marked bag. A sample is taken to the laboratory and oven dried until constant weight to determine water content. Formula for calculating biomass is: $$WL = \frac{W\ field\ fresh}{P} * \frac{W\ dry\ sample}{W\ wet\ Sample} * \frac{1}{100}$$ the amount of biomass per unit area is given by: where: WL = biomass of litter (t ha-1); W field fresh = weight of the fresh field sample of crop residue, destructively sampled within an area of size P [g]; P = size of the area in which litter were collected [ha]; W dry sample = weight of the oven-dry sample of litter taken to the laboratory to determine moisture content [g]; and W wet sample = weight of the fresh sample of crop residue taken to the laboratory to determine moisture content [g]

Sample plot ID	weight of the fresh field sample of crop residue(g)	size of the area in which litter were collected [ha];	Weight of the oven-dry sample of litter taken to the laboratory to determine moisture content [g]	weight of the fresh sample of litter taken to the laboratory to determine moisture content [g].

<table>
<tr><td></td><td></td></tr>
<tr><td>Agro-forestry above ground biomass</td><td>
Step 1 Estimate Above ground biomass using the following equation

$$AGB = 0.112 * [\rho * D^2 * H]^{0.916}$$ [4]

where,
AGB = above ground biomass [kg];
ρ = wood specific gravity [g cm-³];
D = tree diameter at breast height(1.3 meter height) [cm]; and
H = tree height [m]

$$By = 5 * \frac{Nt}{1000}$$

Where:

By = biomass yield; Nt is number of trees in a hectare

The study estimated average annual biomass yield of 5 kg dry mass per tree[1]

	Farm ID	Agro-forestry Tree species name	Area cultivated (ha)	Above Ground Biomass (tonnes per hectare) AGB	Ratio of below ground to above ground	Biomass yield(tonnes/hectare) By
1						
2						
3						
4						
</td></tr>
</table>

Data analysis					
Step 1: Calculation of crop production	Farm Name	Name of crop	Number of bags (N)	Weight of a bag (Wb) kg	Total production (P) annually (tonnes) P=(N*Wb/1000)

[4] STANDARD OPERATING PROCEDURES (SOPs) FOR FIELD MEASUREMENT I Wayan Susi Dharmawan, Kirsfianti Linda Ginoga, Erianto Indra Putra, Alfan Gunawan Ahma

Step 3. Calculation of fertilizer consumption

Calculating the amount of fertiliser required

This information can be used to calculate the amount of a fertiliser consumed:

Record readings for each Sample Plot under different farming type (i.e. agro-forestry, conservation farming, conventional farming)

Record for agriculture consumption

Farm name/ID	Type of agriculture	Area applied (ha)	Number of bags of fertiliser applied		Mass of fertiliser per bag (kg)		Total fertiliser consumption	
			D compound (D)	Urea (U)	D compound(kg/bag) (Dm)	Urea (kg/Bag) (Um)	Total D compound (tonnes)= D*Dm/1000	Total Urea (tonnes)= U*Um/1000
	Conservation farming							
	Reduced tillage							
	Conservation							
	Conventional							
	Agroforestry							

Step 4. Calculation of rice cultivation data

	Farm name/ID	Rice cultivation practice	Harvested Area(ha)	Cultivation Period for rice (Days)
1		Upland rice		
2		Irrigated rice		
3		Rainfed		

Step 2: Estimation of uncertainty and confidence values

Step 2 a calculate the arithmetic mean (mean) is the average value of the replicated samples (i.e., sample units) using equation 1 below:

$\bar{x} = \frac{1}{n}\sum_{i=1}^{i=n} x_i$, ---equation 1

Where $\bar{x}$ is the mean, x is the sampled value, and n is number of sample units

Step 2 b calculate standard deviation provides a measurement of variation from the average value using equation 2 below:

	$S = \sqrt{\frac{1}{n-1}\sum_{i=1}^{i=n}(x_i - \overline{x})^2}$ --equation 2 Where S is the sample standard deviation, x is the sampled unit value, n is the number of sample units, and $\overline{x}$ is the arithmetic mean. This equation is applicable to simple random sampling. **Step 2 c calculate** the standard error provides the standard deviation of the mean. $SE_{\overline{x}} = \frac{s}{\sqrt{n}}$---*equation 3* Where SE is the standard error, $\overline{x}$ is the arithmetic mean, s is the sample standard deviation, and n is the number of sample units. This equation is applicable to simple random sampling. **Step 2 d: The confidence interval** gives the estimated range of values likely to include an unknown population parameter at the chosen confidence level. *CI=t** $SE_{\overline{x}}$--*equation 4* Where *CI* is the half width of the confidence interval at a specific confidence level or absolute error, often 95% or 90%, t is the t-value, function of the confidence level and the number of sample units, SE is the standard error, and $\overline{x}$ is the mean. **Step 2 e: Calculate uncertainty** or relative margin of error, which is estimated as a percentage, using the half width of the confidence interval as a percent of the mean. $Uncertainty = \frac{Cl}{\overline{x}}$---*equation 5* Where CI is the half width of the confidence interval at a specific confidence level, and $\overline{x}$ is the mean. $U_{total} = \sqrt{U_1^2 + U_2^2 + \cdots .. + U_n^2}$------------------------------------*equation 6* Where U_{total} is the total percentage uncertainty in the product of the quantities, at the chosen *CI*, and U_n is the percentage uncertainty associated with each of the quantities.

	$$U_{total} = \frac{\sqrt{(U_{1*}x_1)^2+(U_{2*}x_2)^2+\cdots\ldots+(U_{n*}x_n)^2}}{\lvert x_1+x_2+\cdots..+x_n \rvert}$$ -------------------------*equation 7* Where U_{total} is the total percentage uncertainty in the product of the quantities, at the chosen CI, U_n is the percentage uncertainty associated with each of the quantities, and X_i

6.0 SOP QUALITY ASSURANCE/QUALITY CONTROL

Those responsible for aspects of data collection and analysis should be fully trained in all aspects of the field data collection and data analyses. Standard operating procedures should be followed rigidly to ensure accurate measurement and remeasurement. It is highly recommended that a verification document be produced and filed with the field measurement and calculation documents that show that QA/QC steps have been followed.

Quality management	
QA / QC procedures	*Note: multiple re-measurements for all samples are not considered in this SOP template. Some modifications would need to be introduced in countries where such multiple re-measurements for all samples are planned.* **Sub-step Q1.** The coordinator provides warning labels or excludes impossible transitions through logical checks built into response design. **Sub-step Q2.** The coordinator conducts ongoing hot, cold and auxiliary data checks during data collection and conduct regular review meetings among all analysts. **Auxiliary data checks:** use an external data source, such as externally created maps, to compare to the sample unit classification. Discrepancies between the two datasets can be flagged for rechecking. Confirmed differences between the two datasets can be documented to show-case why sample-based area estimation may give different results than other data sources. **Cold checks:** sample units that are randomly selected from the data produced by interpreters. The decisions made by the interpreters are reviewed by the coordinator or group of interpreters meeting together. If the error by the interpreter reflects a systematic error in their interpretation, it is discussed directly with the interpreter and the affected sample units are corrected. **H checks:** sample units that are flagged as low confidence. These marked sample units should be further reviewed by the coordinator or group of interpreters meeting together. Once reviewed, labels that are deemed to be incorrect on these sample units should be adjusted by the interpreter.

Quality Assurance

Data collection in field:

During all data collection in the field, the crew member responsible for recording must repeat all measurements called by the crew member conducting the measurement. This is to ensure the measurement call was acknowledged and that proper number is recorded on the data sheet. In addition, all data sheets should include a 'Data recorded by' field with the name of the crew member responsible for recording data. If any confusion exists, the transcribers will know which crew member to contact.

After data is collected at each plot and before the crew leaves the plot, the crew leader shall double check to make sure that all data are correctly filled. The crew leader must ensure the data recorded matches with field conditions, for instance, by verifying the number of trees/animals recorded.

Data sheet checks:

At the end of each day all data sheets must be checked by team leaders to ensure that all the relevant information was collected. If for some reason there is some information that seems odd or is missing, mistakes can be corrected the following day. Once this is verified and potential mistakes checked, corrected data sheets shall be handed over to the person responsible for their safe keeping while the crew is still in the field. Data sheets shall be stored in a dry and safe place while in the field. After data sheets have been validated by crew leaders, the data entry process can commence.

Field data collection Hot Checks:

After the training of field enumerators has been completed, observations of each field team and each team member should be made. A lead coordinator shall observe each field enumerators during data collection of a field plot to verify measurement processes and correct any errors in techniques. It is recommended that the field supervisors switch to a different team to ensure data collection procedures are consistent across all field teams . Any errors or misunderstandings should be explained and corrected. These types of checks should be repeated throughout the field measurement campaign to make sure incorrect measurement techniques have not started to take place.

Data Entry checks:

To ensure that data is entered correctly, the person entering data (whether during fieldwork or after a return to the office) will recheck all the data entered and compare it with the original hard copy data sheet before entering another sheet. It is advised that field team leaders either enter the data or participate in the data entry process. Team leaders have a good understanding of the field sites visited and can provide insightful assistance regarding potential unusual situations identified in data sheets. Communication between all personnel involved in measuring and analyzing data should be used to resolve any apparent anomalies before final analysis of the monitoring data can be completed. If there are any problems with the plot data (that cannot be resolved), the plot should not be used in the analysis.

Quality Control

Field measurement error estimation

A second type of field check is used to quantify the amount of error due to field measurement techniques. To implement this type of check, a complete remeasurement of a number of plots by people other than the original field enumerators is performed. This auditing team should be experienced in forest measurement and highly attentive to detail. A total of 10% of plots (or clusters if clustered plots are used) should be randomly or systematically chosen to be remeasured. Where clustered plots are used, all plots within a selected cluster shall be measured. All trees or livestock shall be remeasured in each plot or livestock farm+. Field teams taking measurements should not be aware of which plots will be remeasured whenever possible.

After remeasurement, data analysis is conducted and biomass estimates are compared with estimates from the original data. Any errors discovered could be expressed as a percentage of all plots that have been rechecked to provide an estimate of the measurement error.

Data Entry quality control check:

After all data has been entered into computer file(s), a random check shall be conducted. Sheets shall be selected randomly for re-checks and compared with data entered. Ten percent of all data sheets shall be checked for consistency and accuracy in data entry. Other techniques such as data sorting and verification of resulting estimates shall be employed to ensure data entered properly corresponds to field sites visited. Personnel experienced in data entry and analysis will be able to identify errors especially oddly large or small numbers. Errors can be reduced if the entered data is reviewed using expert judgment and, if necessary, through comparison with independent data.

QA/QC of Laboratory Measurements

Standard operating procedures (SOPs) should be created and rigorously followed for each part of all laboratory analyses. All instruments should be calibrated. For example, all combustion instruments for measuring total C or C forms should be calibrated using commercially available certified C standards. SOPs should include steps to calibrate and check analyses. Blanks can be analyzed, or analytical runs can include a check sample of known C concentration. One standard per batch/run should be included in the samples sent to a remote lab as an additional check of the quality of the instruments and lab procedures.

All balances for measuring dry weights should be calibrated against known weights. Where possible, 10-20
% of samples could be reanalyzed/reweighed to produce an error estimate

7.0 SOP DATA STORAGE AND ARCHIVING

Field equipment
Field log book/electronic
field log book Laptop
computer
Desktop

This SOP describes the methods for storing and archiving data in a simple yet safe and retractable way, so data can be accessed whenever necessary. Data storage and archiving is a very important and final component of the data collection process. The basic framework involving data storage and archiving follows.

Data storage in the field

In the field one person is responsible for storing and keeping the field data sheets; this person can also be the person who also validates the data on the sheets and is one of the team leaders.

If the data entry process is being done or started in the field, these sheets will be used after which they must be returned to the person responsible for their safe keeping. These sheets are stored in a dry and safe place where they cannot be tampered with until they are transported to the office.

Data storage in the Office

In the office, all original field data sheets shall be scanned and compiled into a document to be stored electronically. This avoids any changes to be made to the original sheets.

Hard copy

The original data sheets are photocopied and are kept in separate location. The data sheets are placed in a special jacket folder in the filing cabinet with the location name and date written on the label. Inside of these jackets there are folders with the different types of data collected (Biomass, Logging, Skid trails, Roads and Decks, Regrowth, Wood Density etc.). After all data has been entered into a digital format and SOP QA/QC completed, the two sets of data sheets are then stored in secure fireproof filing cabinets in two separate locations.

Soft Copy

The scanned data sheets are stored on a computer in the office, along with all tools with the entered data, including data entered in the field laptop. These data files are backed up on a server. Folders containing data and folders containing tools should be properly named and adequately organized. All digital data collected and compiled (photos, proposal and report for exercise) are also stored in the archive file on both the desktop in the office and on the server. On the server there are a few folders in which all data are placed as follows:

1. '*Field Data*', in which sub folders are created and are named the same way

(Location) as the hard copy folder so as to have a uniform filing system. In each sub folder there are two folders; pictures and scanned data sheets in which the respective information are placed;

2. '*Data Analysis*' in which all completed tools are placed after the data entry has been completed;
3. '*Template*' in which all tool templates and field data sheets used in the data analysis are placed;
4. '*Documents*' in which all documents related to the project are placed; and
5. '*Field Proposal & Report'* in which all field exercise proposals

and report are placed.

Procedure for Data File Backup

Any file(s) that is updated during the data analysis will be backed up to a network server. This back up will be done daily on the office computer(s), and at the end of every week they **must** be saved on an external hard drive and the folder on the server which is specifically designated for this data storage.

Procedure for Compiling and Managing Field Logbook or Electronic Log Book

This logbook will be both of an electronic form and of the traditional book keeping format (a book). Both log forms will be updated simultaneously and twice for each field venture, before and after each trip. Logbooks will be used for recording the logistics of the field exercise, and providing explanation about field campaigns (e.g. date of departure to the field and date of returning, number of plots, location, field crew, challenges etc.). Each field campaign will be given a unique reference number and each report will also be given a reference number related to that of the campaign. This is to facilitate cross referencing processes.

Upon returning to the office after field records are entered, the log books will be stored in a secure filing cabinet or placed on the network server via desktop computers respectively, after being updated. Upon the completion of field reports of which each report will be given a unique reference number, the log books will be revisited and the report number will be inserted for future references. It is important to restrict access to logbooks and information only to users, as they alone are responsible for making changes.

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2. Harper, L.A., Sharpe, R.R. and Parkin, T.B. (2000). Gaseous emissions from anaerobic swine lagoons: Ammonia, Nitrous Oxide, and Dinitrogen Gas.
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Ministry of Green Economy and Environment

Zambia Integrated Forest Landscape Project

Improving lives through Sustainable Management of Natural Resources

The Zambia Integrated Forest Landscape Project is a Government initiative which provides support to rural communities in the Eastern Province to allow them to better manage the resources of their landscapes so as to reduce deforestation and unsustainable agricultural expansion; enhance benefits they receive from forestry, agriculture, and wildlife; and reduce their vulnerability to climate change.

Simultaneously the project is creating the enabling environment for emission reduction purchases to be done through the subsequent phase - the Zambia Eastern Province Jurisdictional Sustainable Landscape Programme (EP-JSLP).

The ZIFL- Project is a product of cooperation between the Government of Zambia, the World Bank & partners.

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