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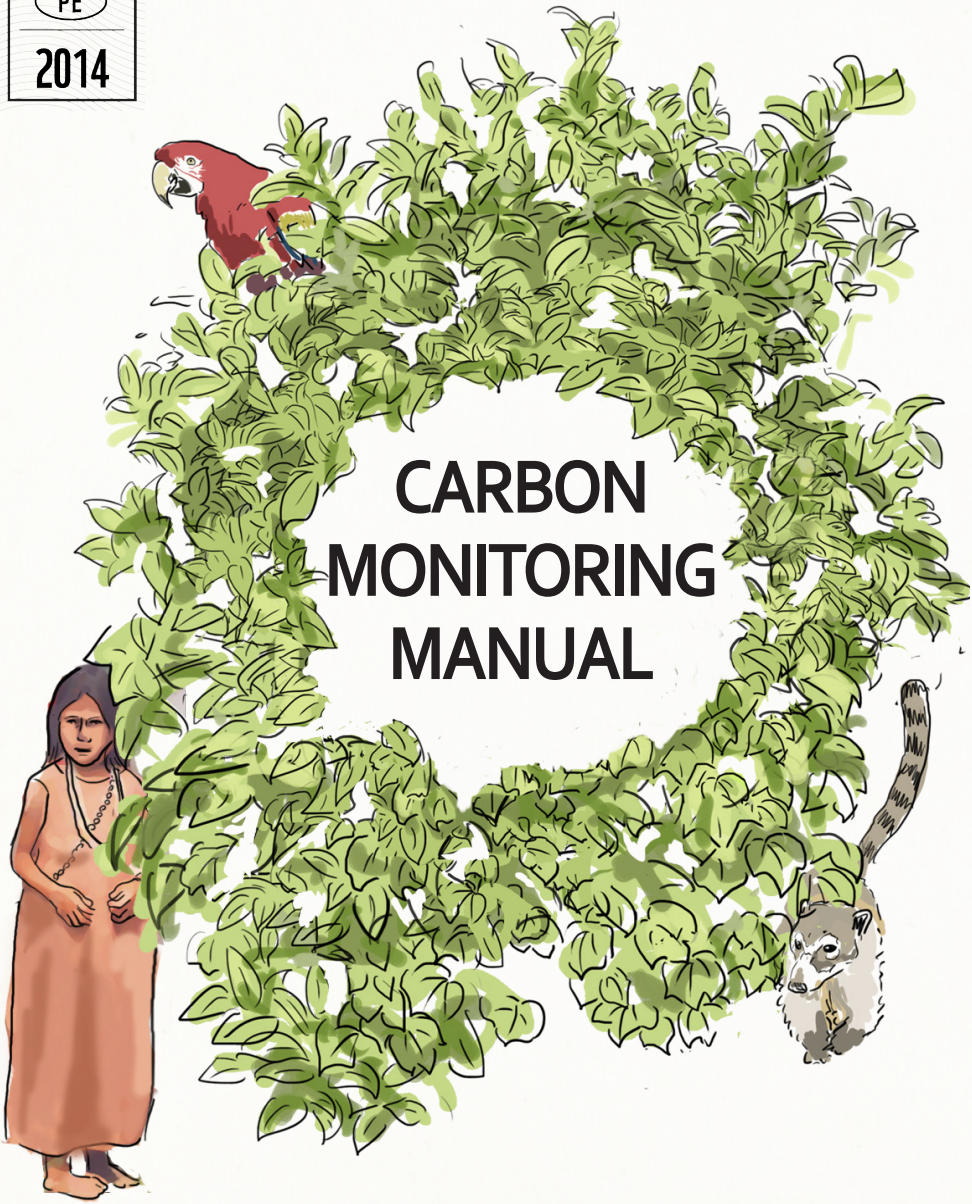
PE

2014

CARBON MONITORING MANUAL



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WWF's mission is to stop the degradation of our planet's natural environment and to build a future in which people live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

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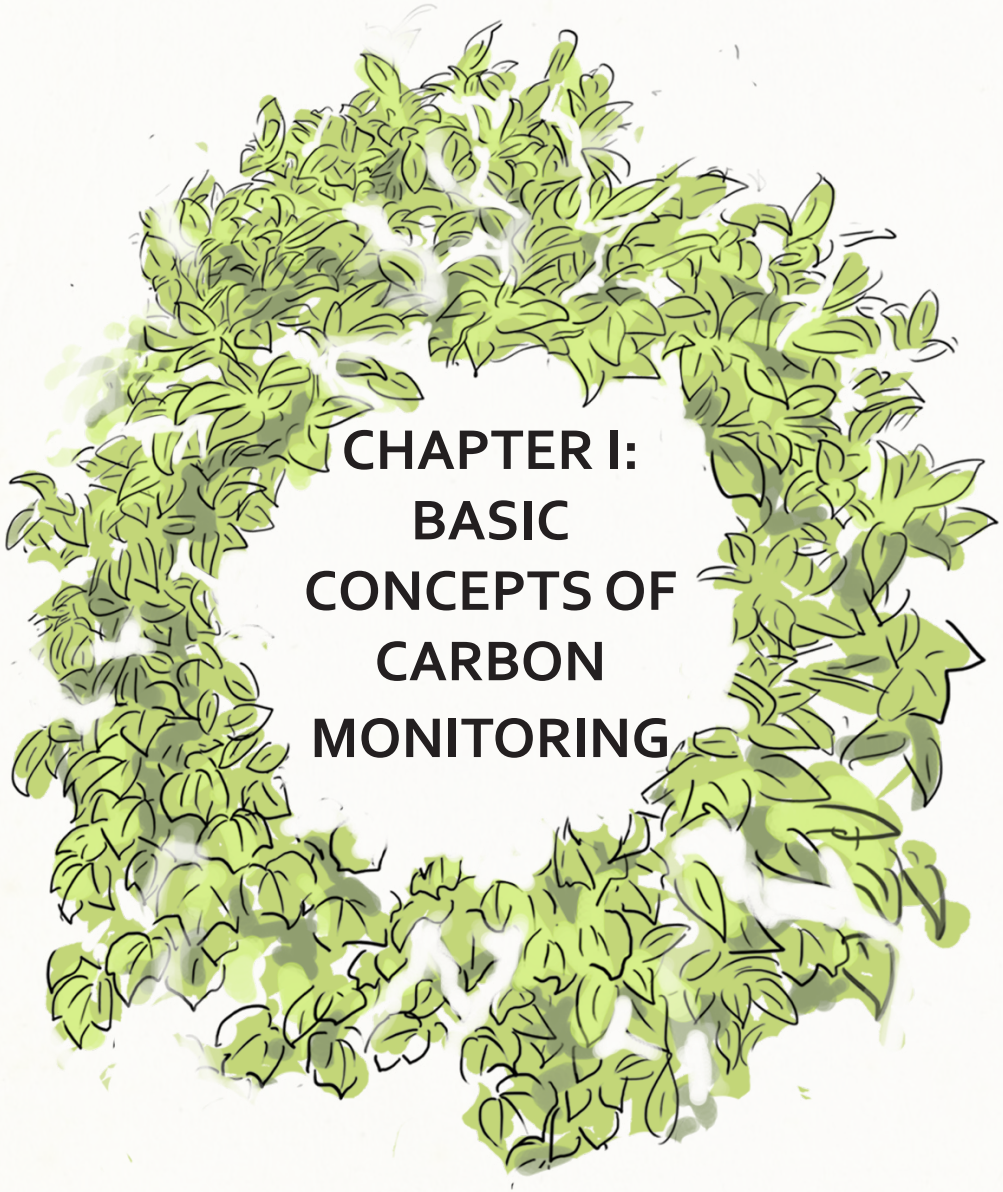
INTRODUCTION

Tropical forests are not only a major source of natural resources, but also a key mechanism to reduce global warming. This is mainly due to their potential to capture carbon dioxide (CO_2) from the atmosphere and store it, thus becoming one of the largest natural carbon stocks. However, forests have been significantly reduced due to increasing deforestation worldwide, causing more CO_2 levels in the atmosphere to rise.

It is important to value forests because of their key role in carbon sequestration and storage, and regulating the carbon cycle balance in the globe. However, understanding how this cycle works is not widely known, particularly due to complexity and lack of training.

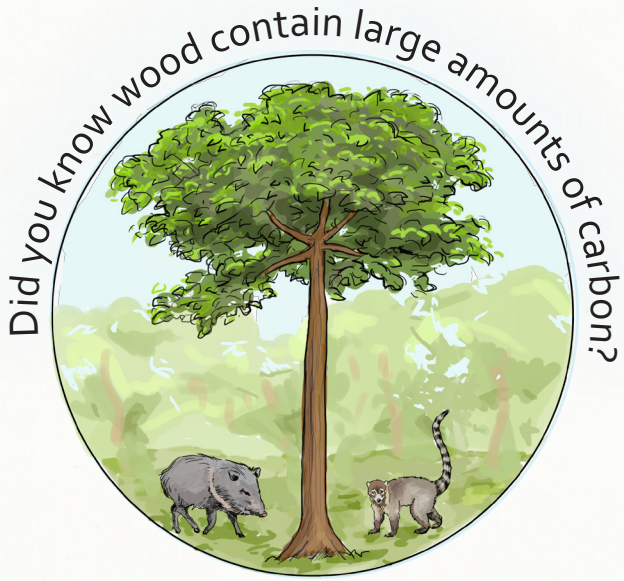
This manual aims to provide a basic overview of carbon, biomass, measurement and monitoring of carbon flows stored in our forests in order to further understand its importance to reducing climate change by maintaining 'standing forests.'



CHAPTER I: BASIC CONCEPTS OF CARBON MONITORING

WHAT IS CARBON?

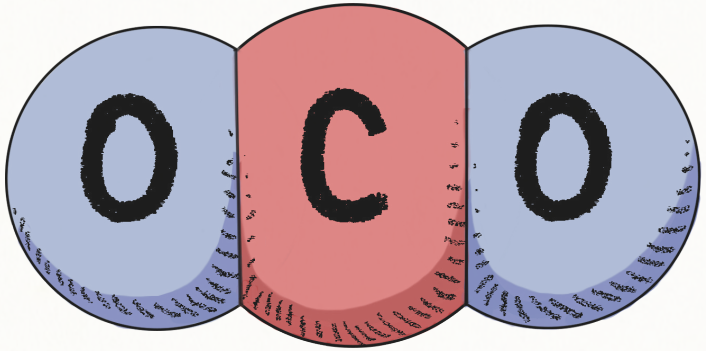
Carbon is a very common natural element on our planet and it is part of all living things. All organisms need carbon to grow.



Since carbon may take many forms, it can be found in almost every corner of our planet. For instance, it is found in rocks, soil, air, water and even gases, such as carbon dioxide.

¿WHAT IS CARBON DIOXIDE?

Carbon dioxide is a dense, colorless gas found naturally in the atmosphere. The carbon dioxide (CO_2) molecule consists of two atoms of oxygen and one of carbon.



Carbon dioxide (CO_2) is formed when carbon contained in things becomes a gas and bonds with oxygen in the air.

WHEN DOES CARBON BECOME A GAS?

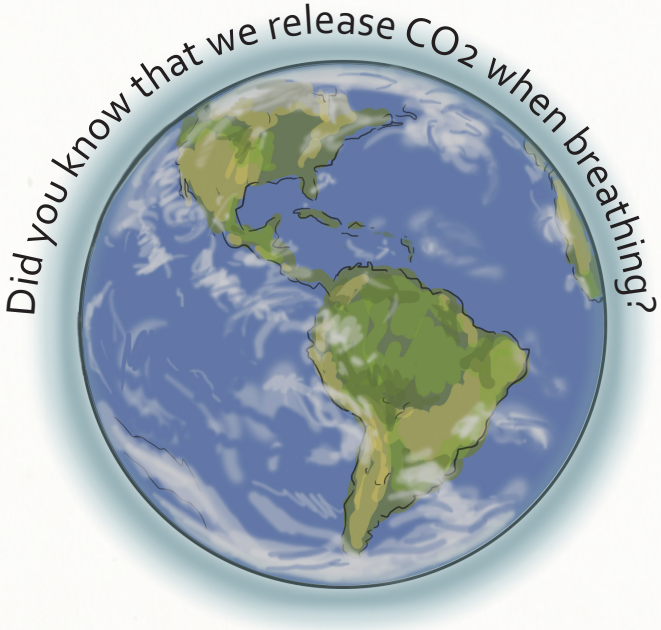
When plants or trees die and decompose

When anything containing carbon is burned.

When we use fuels to run engines, vehicles, machinery, etc.

WHAT DOES CO_2 HAVE TO DO WITH US?

CO_2, stored in the layer of gases surrounding the Earth, is essential to our lives for many reasons.

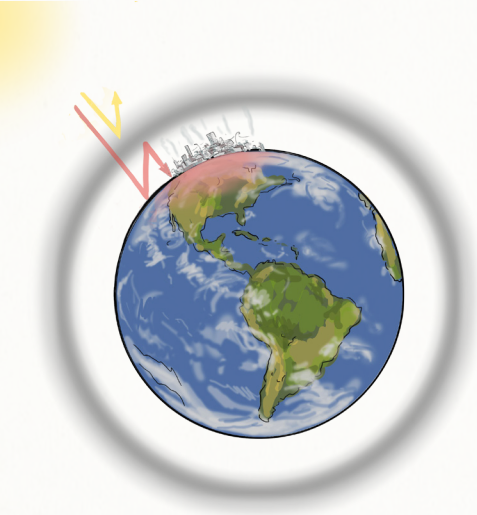


First, CO_2 helps to regulate temperatures for life on our planet. Nights would be much colder without CO_2.

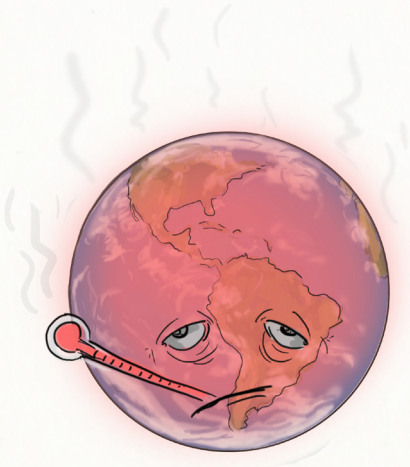
Additionally, CO_2 and other gases form a layer in the atmosphere prevent sunlight from reaching the Earth during the day, and retain heat during the night. This is known as the greenhouse effect.

This gas layer has an important effect on the climate because it keeps the sun's heat within the Earth's atmosphere. This works as a blanket to protect us from cold temperatures during the night, like a woolen cap.

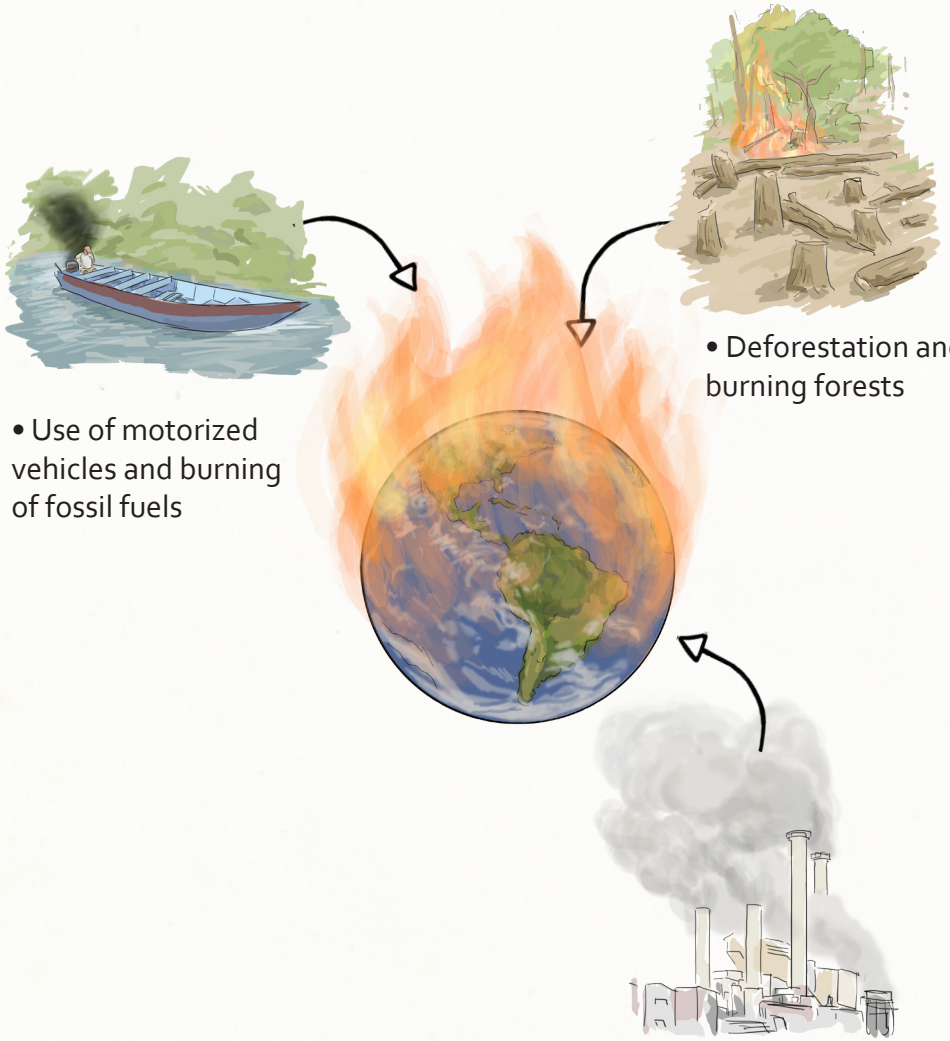
The more CO_2 in the atmosphere, the more heat trapped on Earth.



This is happening right now! CO_2 in the atmosphere is making the Earth warmer than usual; this is known as Global Warming.



WHAT IS CAUSING MORE CO_2 TO BE RELEASED INTO THE ATMOSPHERE?



- Use of motorized vehicles and burning of fossil fuels
- Deforestation and burning forests
- Industry emissions

WHAT CAN WE DO TO REDUCE CO_2?

Controlled burning

- Plant trees – because they capture carbon dioxide and release oxygen.

- Maintain standing forests – because they store carbon.

- Practice controlled burning – to avoid releasing too much CO_2.

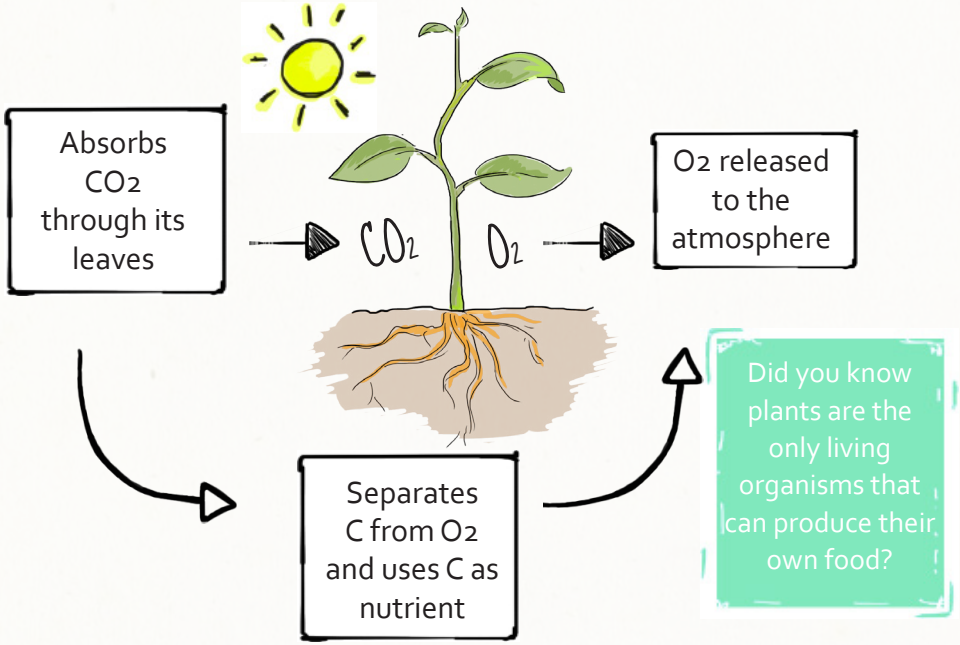
SEQUESTRATION AND CARBON STOCKS

Every tree and plant forming forests absorbs CO_2 and stores carbon in its trunks and branches, becoming lifetime carbon deposits. Depending on the species, a tree can store carbon for hundreds of years.

FORESTS ARE KEY TO REDUCING CO_2!

The more standing forests we have, the more carbon dioxide will be captured and stored by plants and animals living in these landscapes; therefore maintaining a natural carbon reserve.

HOW DO PLANTS CAPTURE CARBON?

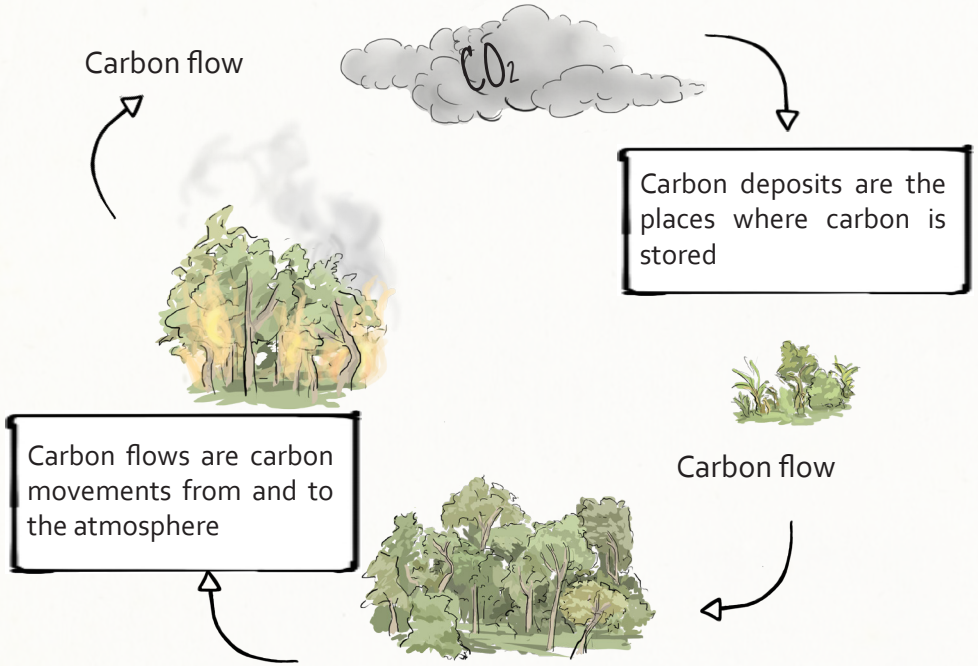


Plants transform CO_2, water and soil minerals into food by using the sun's energy. This process is known as:

PHOTOSYNTHESIS

CARBON CYCLE

In nature, the carbon cycle is well balanced, which means the amount of CO_2 released offsets the amount of CO_2 absorbed.



Nowadays, there is more carbon released than stored. This causes a serious environmental problem – **global warming** – which is changing the world's climate conditions.

Therefore, we all must focus on reducing CO_2 emissions.

We can reduce global warming by planting more trees and halting illegal logging in our forests!

HOW DO NON-FOREST COUNTRIES REDUCE CO_2?

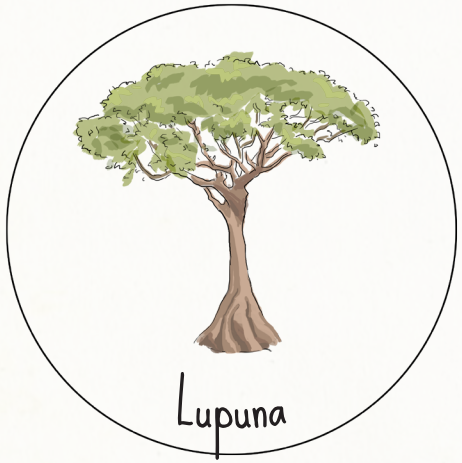
Forests provide a key environmental service to the world: **they absorb CO_2.**

As compensation for this environmental service, non-forest countries which release large amounts of CO_2 could provide support to maintain or increase forested areas in critical places. Thus, it is important to know how much carbon plants absorb. The more carbon is stored in a forest, the more important it is to keep it 'standing'.

HOW DO WE KNOW THE AMOUNT OF CARBON STORED IN OUR FORESTS?

Trees can store more or less carbon depending on the species.

The shihuahuaco *(Dipteryx sp)* stores more carbon than a lupuna *(Ceiba sp.)* of the same size. Although both trees are big, their wood densities are different.



Hence, to know the amount of carbon stored by these trees, we must know their biomass.

WHAT IS BIOMASS?

It is the total weight of organic matter produced from solar energy. For example, we use part of the forest biomass for our food needs: fruits, leaves, animals and energy used to cook our food – firewood.

Did you know charcoal has higher caloric value than firewood?

To measure the biomass of a tree, we must know the total weight of a tree's organic matter, without considering water weight. Henceforth, there is a protocol of terrestrial carbon measurement developed by Winrock International.

CHAPTER II: BIOMASS MEASUREMENT FOR CARBON MONITORING

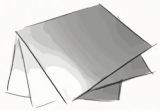
FIELD SAFETY

Safety is the most important thing to consider when doing any field activity. Here are some important steps to avoid field accidents.

- Consider safety measures according to the activity.
- Avoid unnecessary risks.
- Have company while going into field activities.
- Use appropriate forest equipment (boots, pants, long-sleeved suit, etc.).

ESTABLISHMENT OF PLOTS

Equipment:



Numbered aluminum sheets

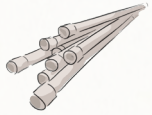
Aluminum nails

Eye-catching paint

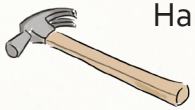
GPS

Marking tape

PVC tube (1 m)



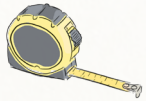
Permanent marker



Hammer

Girth bands.

Measuring tape



PLOT SHAPES

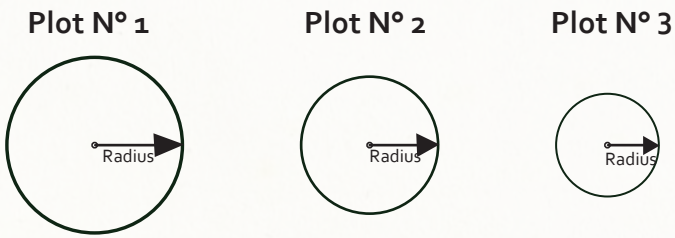
Plots can be circular, square or rectangular. Circular plots are more efficient because it is not necessary to mark a plot's borders – only the plot's center. Therefore, this manual explains how to install a circular plot.

Nested circular plot

Nested plots are made of many plots in the same forest area – one inside of another (between 2-4 plots depending on the forest type). Each of these plots is separately assessed. Here is how to install a nested circular plot of tree plots.

PLOT SIZE

There are certain rules to apply in most of the projects to determine the plot's size. After trial and error, the following plot sizes work best.



The three plots will have the same central point on the field.

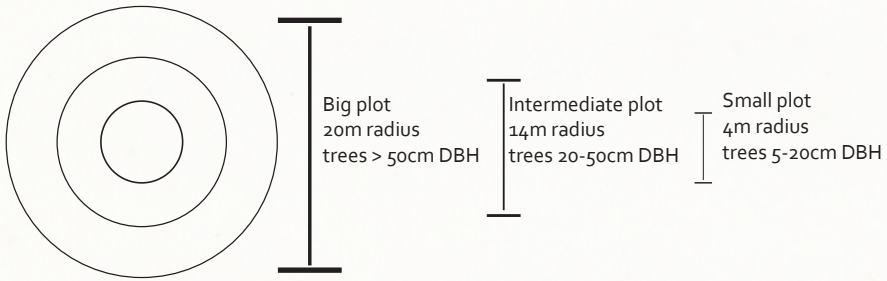
For carbon monitoring, we will use a nested circular plot with the following characteristics:

PLOT RADIUS	WHAT WE SHOULD MEASURE
4 meters	Trees of 5-20cm (DBH)*
14 meters	Trees of 20-50cm (DBH)
20 meters	Trees higher than 50cm (DBH)

* DBH = Diameter at breast height (trunk thickness at breast height). Breast height is measured at 1.30m from the trunk's base.

DIAGRAM OF NESTED CIRCULAR PLOT

When putting the plots together at the same point, the diagram of the nested plot looks like this:



The plot's radius is the distance from the plot's center to any point on the plot's border. For example, bicycle's wheels have many radiuses to support its structure.

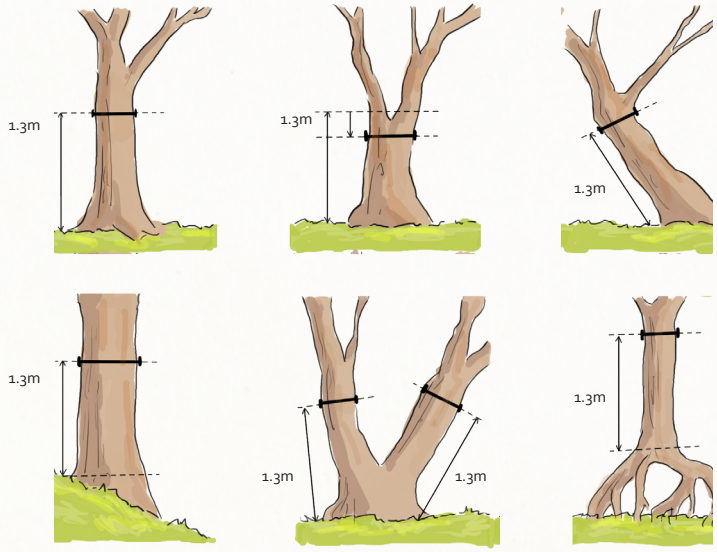
WHICH VARIABLES ARE MEASURED?

1. Diameter at breast height (DBH).

There are many ways to measure DBH, depending on the tree's position.

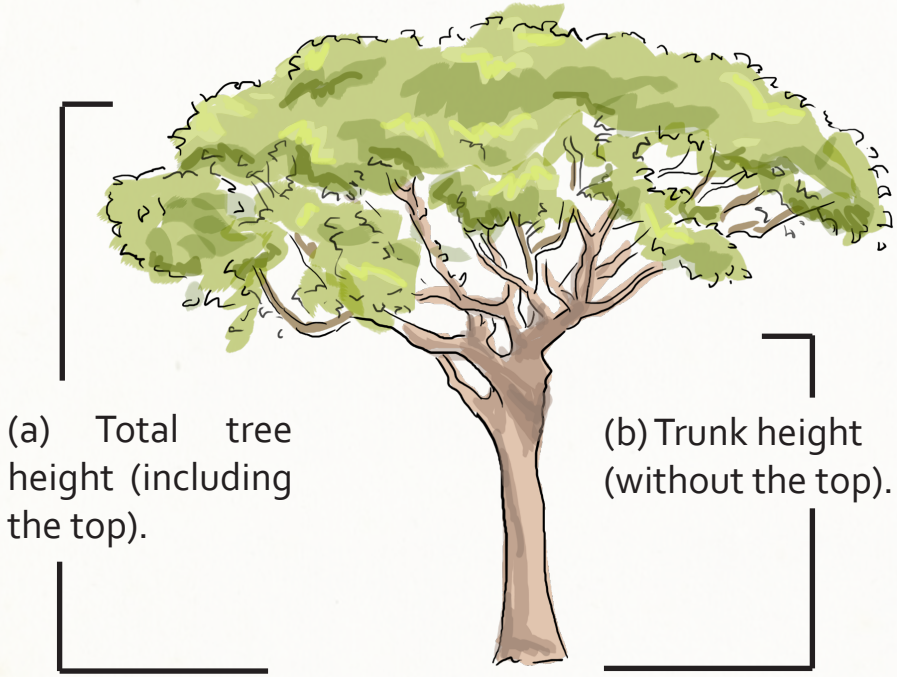
In any case, the DBH must always be measured at 1.30m from the trunk's base.

Here are some examples when measuring DBH.



2. Tree height (estimation).

Two types of heights from each tree in the plot must be estimated.



a. Total tree height.

b. Trunk height (from the trunk base to the beginning of the top).

To measure the tree's height, we must delineate where the tree's top and branches begin.

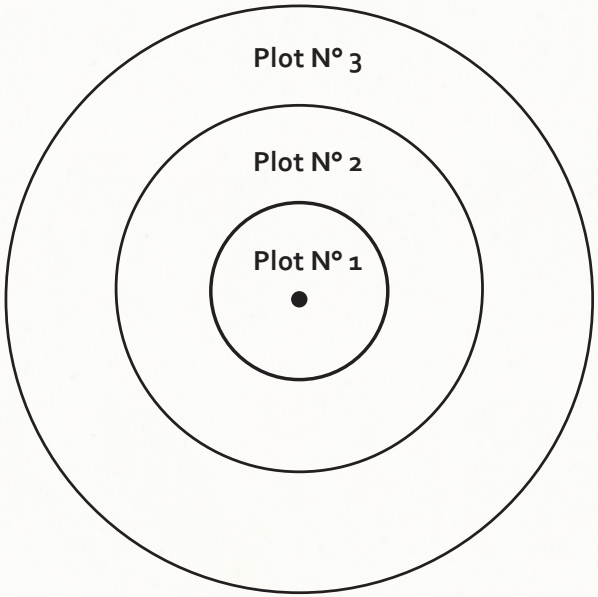
ESTABLISHMENT OF THE PLOT

1. Locate a point within a homogenous forest.

2. Mark the plot central point with the PVC tube.

3. Delineate plots using measurement tapes.
   Measure trees in the three plots, starting by the largest one from the north and in a counter-clockwise direction.

4. Mark trees with aluminum sheets.



Note: Consider the nested plot as three different circular plots with the same center to facilitate fieldwork. In each plot, trees of different diameters are measured.

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ANNEXES

1. Field datasheet

Plot N°:

Nested plot radius:

Location:

Coordinates: x: y:

Land type:

Responsible:

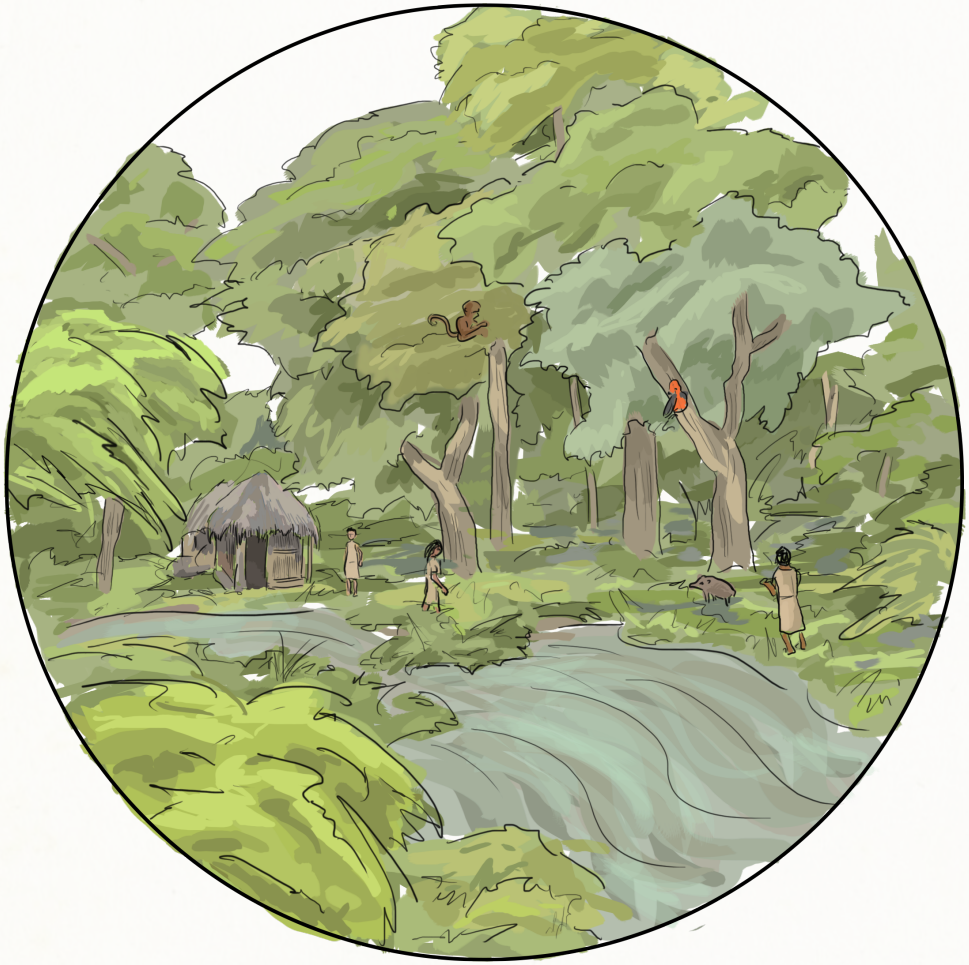
Date:

Starting hour:

End time:

FIELD DATASHEET FOR BIOMASS MEASUREMENT AND SAMPLING

# of tree	Species	Diámeter	Trunk height	Total height	Observations



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