

INQUIRY 4: WHAT DO THE WORLD'S FORESTS HAVE TO DO WITH CLIMATE CHANGE?

THE SITUATION: Is the climate changing over time? You probably have heard many different opinions about climate change. In the past few years, most scientists have agreed on at least one thing about climate change. They have agreed that measured and recorded changes in Earth's climate over the past 100 or more years point to a warming of Earth's surface greater than they would have expected from normal cycles.

Earth's average temperature depends on how much of the sun's energy comes through the atmosphere to Earth's surface, and how much escapes back into space. About 90 percent of the sun's energy is trapped by gases in the atmosphere, including carbon dioxide, methane, and nitrous oxide. This trapped energy is sent back to Earth in all directions, warming the planet. This warming is called the greenhouse effect, and the gases are called greenhouse

gases. Without these gases, humans and other forms of life would not be able to survive on our planet.

During the past 150 years, however, the amount of greenhouse gases in the atmosphere has risen sharply (Figure 40). This increase has been happening since the beginning of the Industrial Revolution in the mid-1700s. The amount has been increasing even more over the past 100 years. Scientists believe the sharp rise in greenhouse gases is caused by an increase in the burning of fossil fuels, such as oil, coal, and natural gas. These higher levels of greenhouse gases in the atmosphere trap more of the sun's heat that is reflected off of Earth's surface. This additional trapped heat leads to increasing temperatures on Earth.

Carbon dioxide is one of the greenhouse gases. Carbon dioxide naturally occurs in our

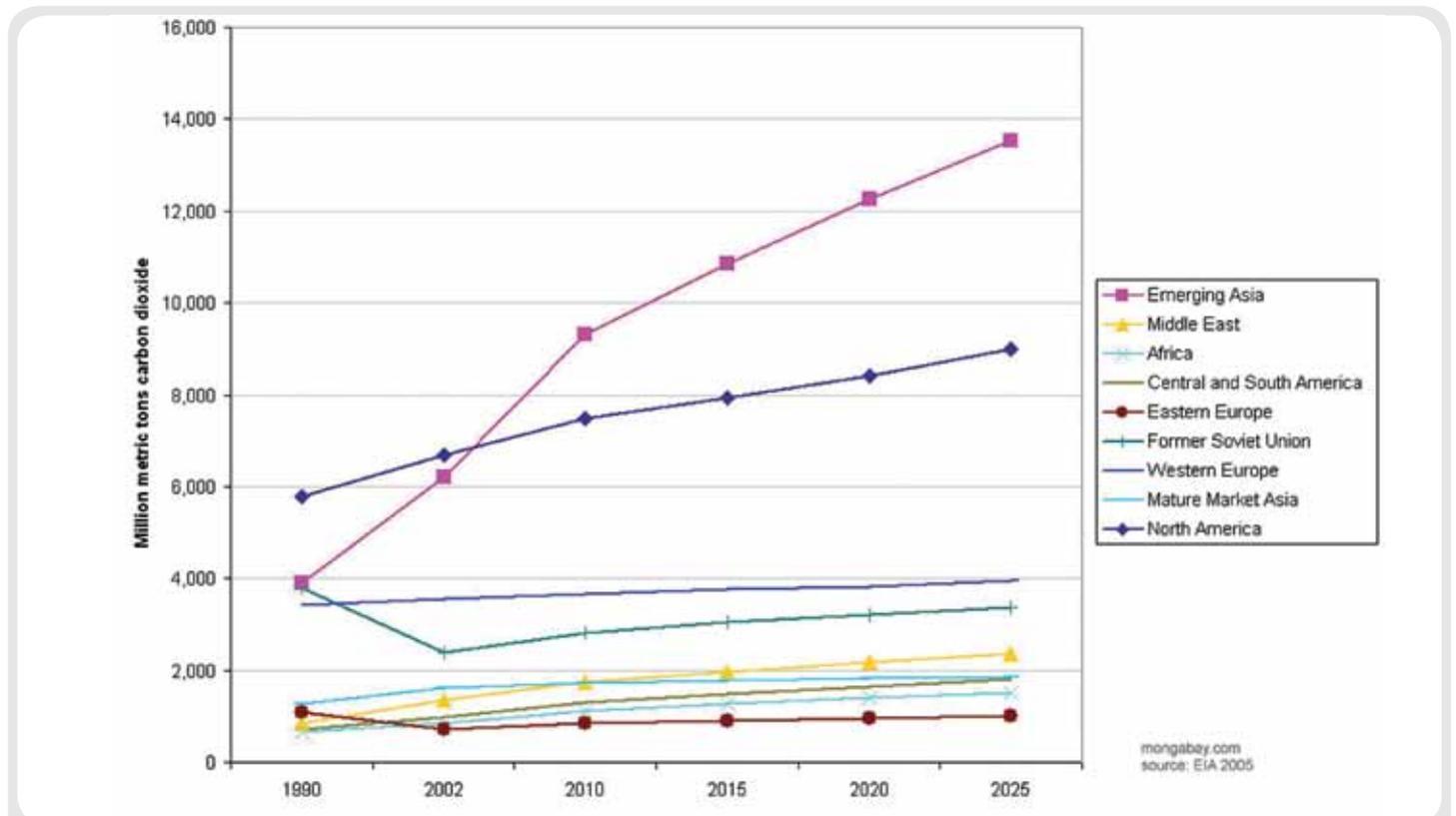


Figure 40. Increase in the world's carbon dioxide emissions, 1990-2025. Carbon dioxide is a greenhouse gas. Source: The United States Energy Information Administration.

atmosphere and a certain amount is necessary to keep Earth warm enough for life to continue. When too much carbon dioxide is **emitted** into the atmosphere, however, Earth's surface continues to get warmer. As Earth's surface warms beyond its normal temperatures, plants and animals are affected.

Carbon is present in rocks, oceans, and the air. Every living thing and once-living thing contains carbon, including all plants and animals. Carbon is always moving around. You can see how it moves in what is called the carbon cycle (Figure 41). Since a tree is a living thing, it also contains carbon. As a tree grows, it absorbs carbon from the air and stores it in its wood (Figure 42). The world's forests are related to Earth's climate because they hold large amounts of carbon on Earth. The carbon stored in the world's forests does not get emitted into our atmosphere unless the trees are felled and burned or when they die and decay. As you can see, the world's forests play a role in helping to reduce the effects of global climate change.

FAO and the National Correspondents wanted to know how much carbon is held on Earth by the world's forests. They also wanted to know whether this number is staying the same, increasing, or decreasing over time.

The amount of carbon in a tree is closely related to the weight of its living material, minus any water. Some scientists estimate that half of a tree's dry weight is carbon. Others estimate that about 45 percent of a tree's dry weight is carbon. FAO, used an estimate of 47 percent to calculate the amount of carbon being held by the world's forests.

WHAT FAO DISCOVERED:

The National Correspondents and FAO used three measures of carbon storage. First, they estimated the amount of carbon being held in trees growing in the forests. Recall that carbon is also present in once-living things.

FAO and the correspondents, therefore, also estimated the amount of carbon in the litter

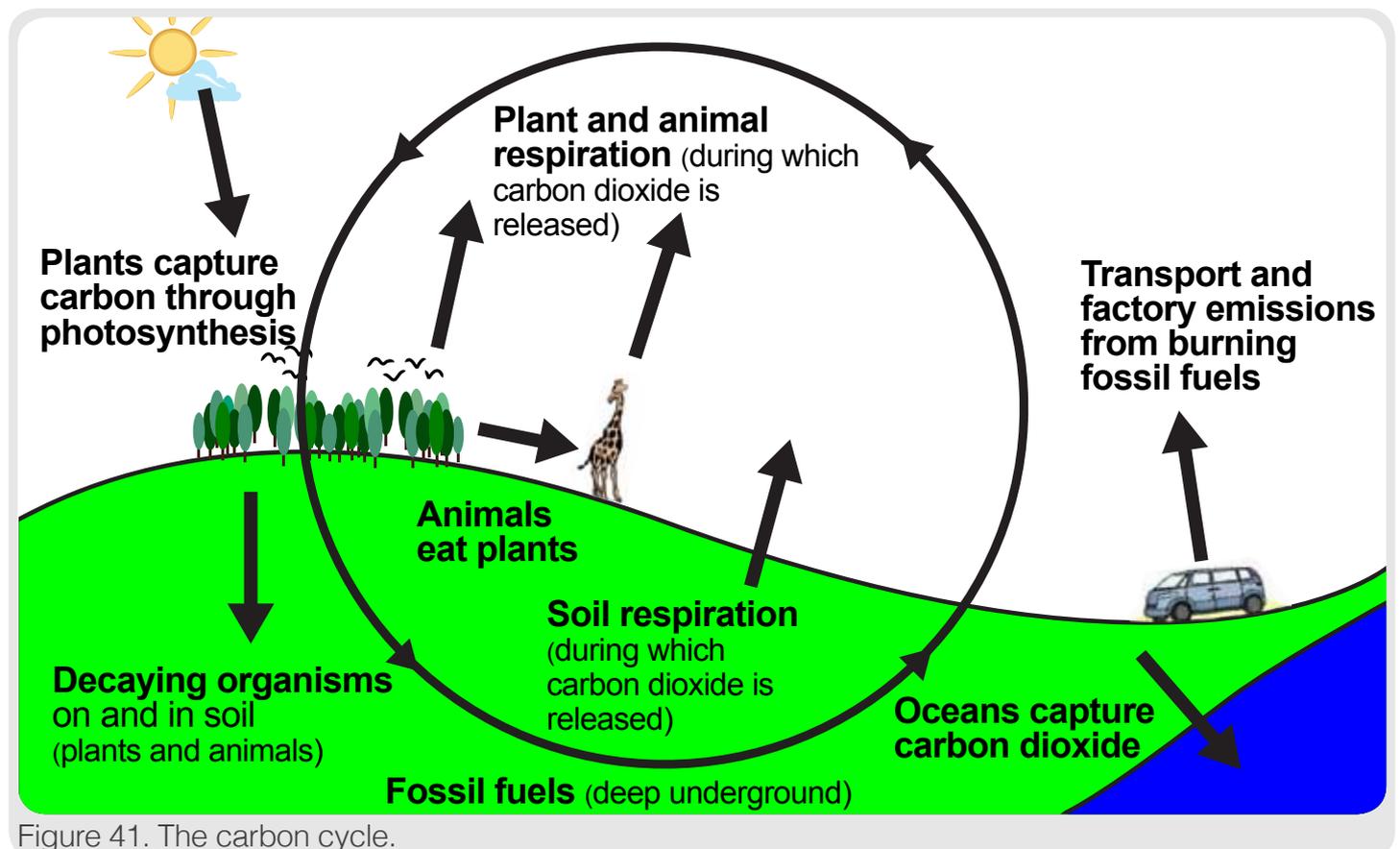


Figure 41. The carbon cycle.

and deadwood lying on the forest floor. Litter includes leaves that have fallen from the trees (Figure 43). Deadwood is the remains of fallen branches and trees that have died (Figure 44). The third measure of carbon was an estimate of the amount of carbon held in the world's forests soils. Because soil contains living beings such as microbes and once-living material, it also contains carbon. Trees also release carbon into the soil (See Figure 42).

The amount of carbon being held in the world's forests' trees was estimated to be 289 Gigatonnes, or Gt (Figures 45 and 47). One Gt is equal to 1 billion tonnes. One tonne is equal to 1 000 kilograms, or 2 205 pounds.

The amount of carbon in the forests' litter and deadwood was estimated to be 72 Gt, or 17.8 tonnes per hectare. Compare this with the

amount of carbon held in the soil, which was estimated at 292 Gt or 72.3 tonnes per hectare. One of the questions FAO wanted to answer is what is happening over time to the amount of carbon being held by the world's forests.

When FAO estimated the amount of carbon being held by the world's forests' trees per hectare, it discovered something surprising (Table 6).

AMOUNT OF CARBON	
YEAR	TONNES/HA
1990	71.8
2000	71.9
2010	71.6

Table 6. Amount of carbon held by the world's forests' trees per hectare between 1990 and 2010.

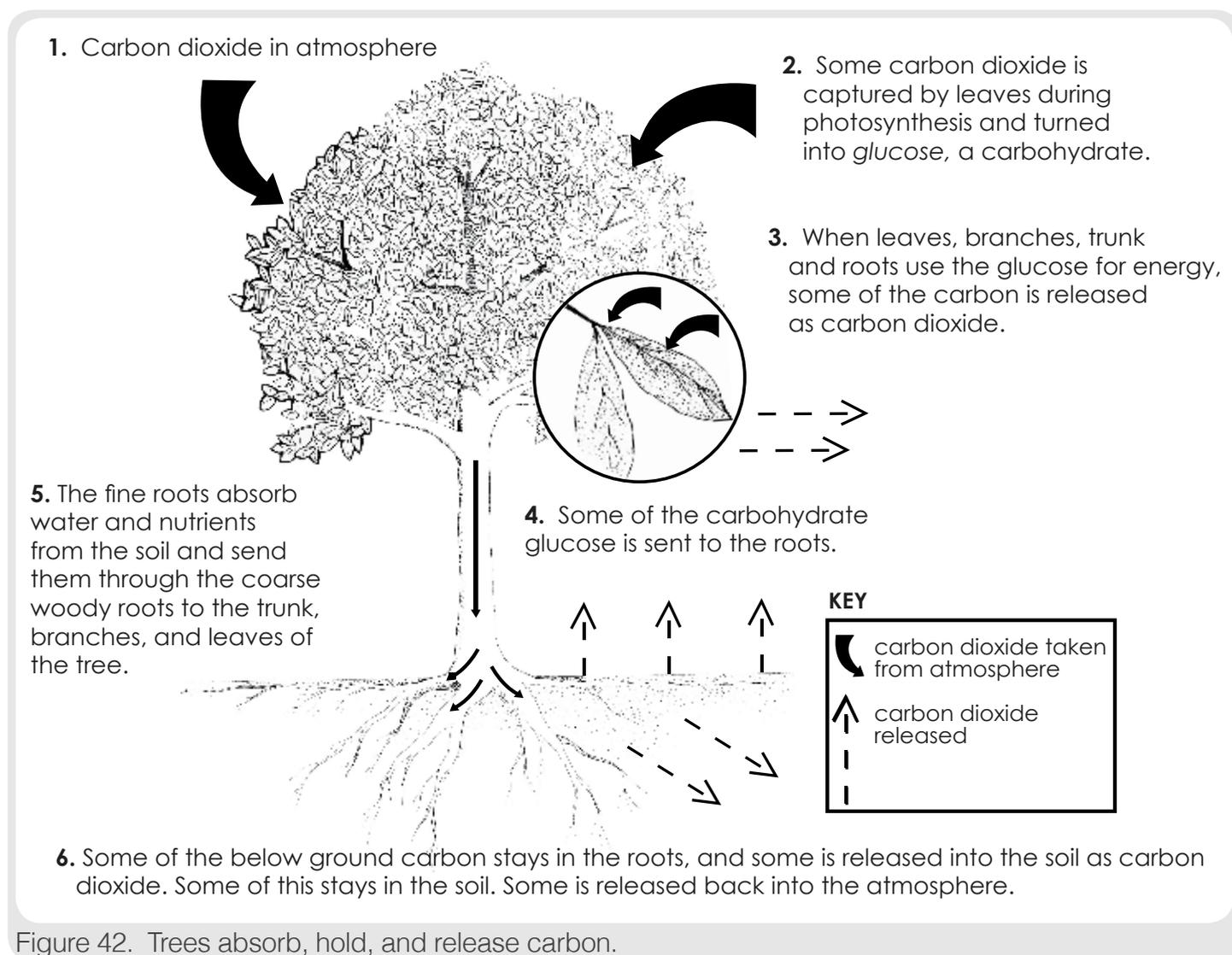


Figure 42. Trees absorb, hold, and release carbon.



Figure 43. Litter is composed of dead and **decomposing** leaves on the forest floor. Photo by Babs McDonald.

YOU DO THE MATH:

Although elephants vary in size and weight, let's say the average weight of an elephant is four tonnes (Figure 46). How many elephants would it take to equal one Gt?

To calculate this, divide 1 000 000 000 by four. How many elephants would it take the equal the weight of carbon in all of the world's forests?



Figure 44. The remains of fallen trees and branches are called deadwood. Photo by Babs McDonald.



Figure 46. African elephant. Photo by Chuck Chappell.

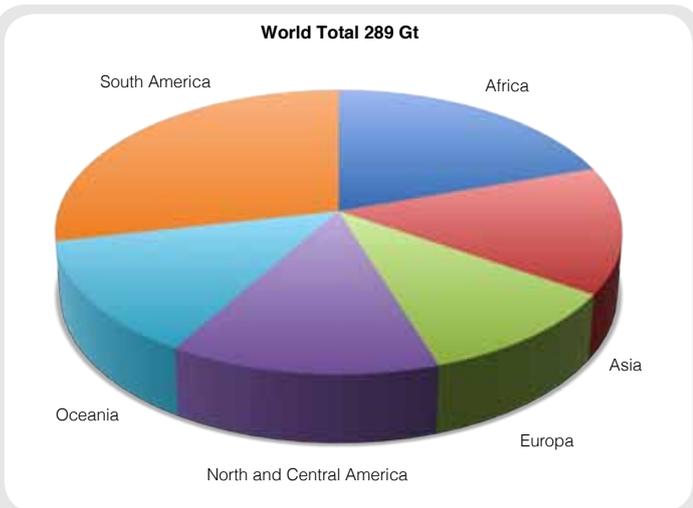


Figure 45. The amount of carbon in the world's forests' trees in Gt by region, 2010.

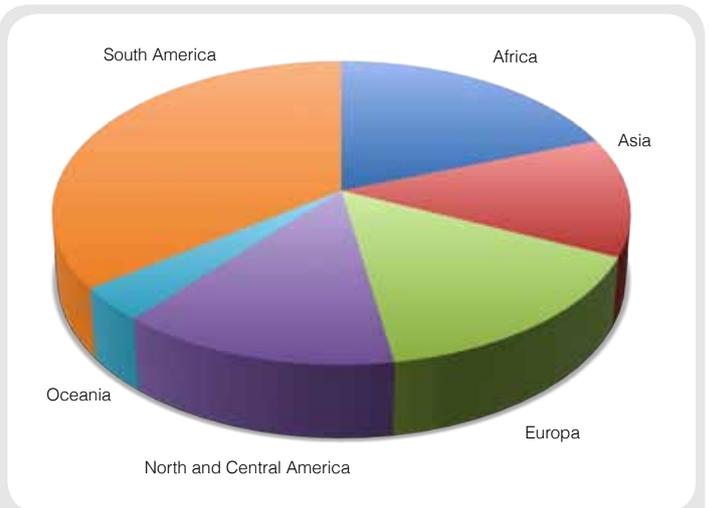


Figure 47. The amount of carbon in the world's forests' trees per hectare by region, 2010.

REFLECTION SECTION:

Do you think that humans contain carbon? Why or why not?

Why should we care whether the world's forests are holding the same amount, more, or less carbon over time?



Over the past 10 years, the average amount of carbon held by a hectare of forest has changed very little. The decrease in carbon held by the world's forests over the past 20 years (Figure 48) is due to the decrease in forest area worldwide (See Inquiry 1).

The United Nations Intergovernmental Panel on Climate Change, or IPCC, is interested in better understanding carbon and its role in climate change. In 2007, the IPCC reported that 17.4 percent of the world's greenhouse gases come from the forest sector. Most of these emissions come from the loss of forests in developing countries (Figure 49).

REFLECTION SECTION:

How do forests help to reduce the impact of climate change?

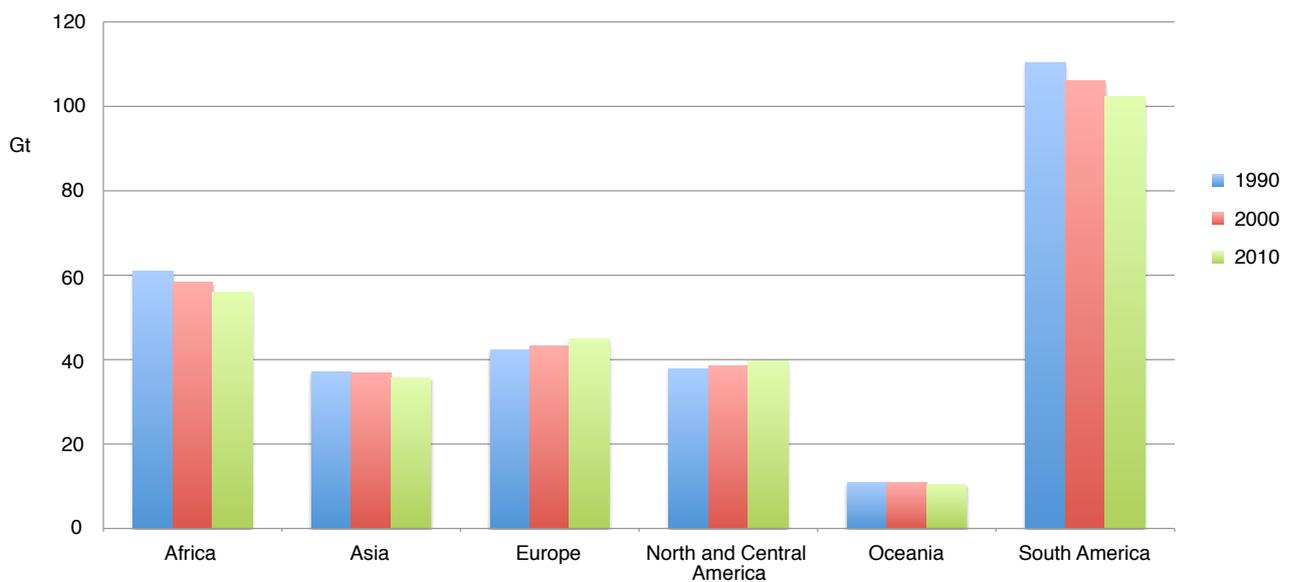


Figure 48. The amount of carbon, in Gt, held in the world's forests' trees between 1990 and 2010 by region.

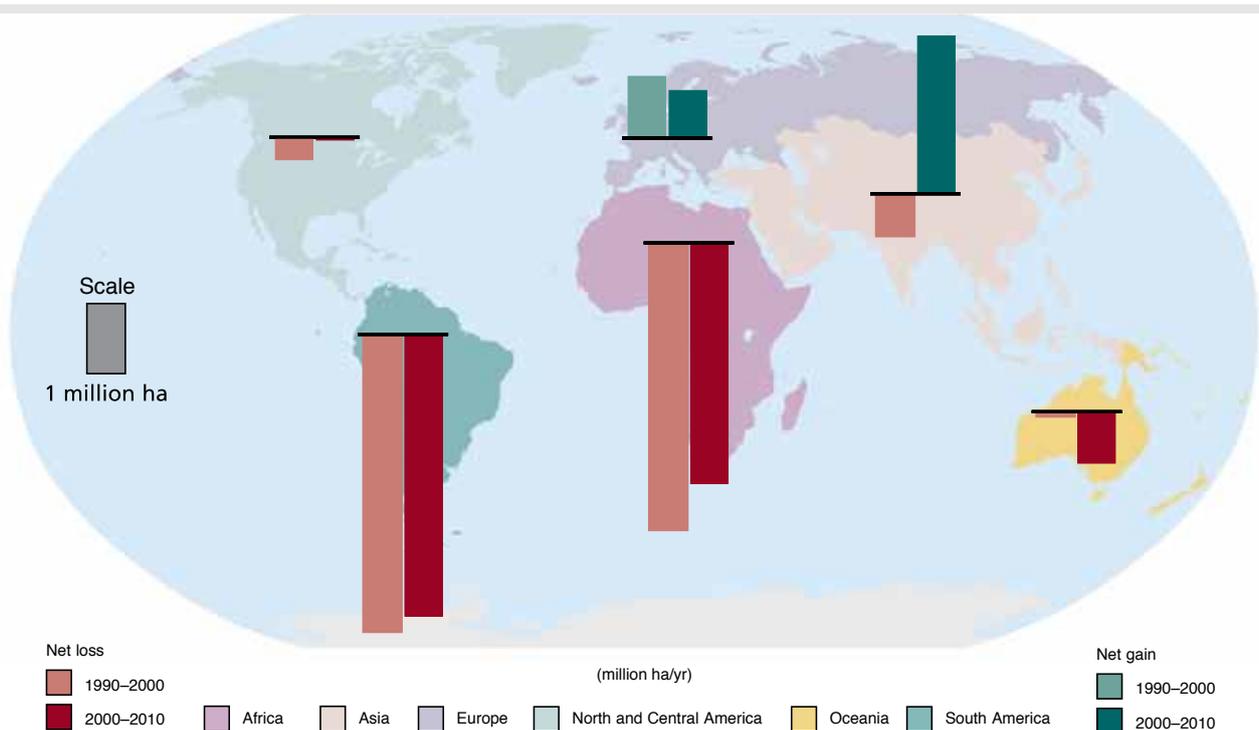


Figure 49. In some regions of Earth, the loss of forests is increasing carbon emissions into the atmosphere.

ACTION ON CLIMATE CHANGE

The United Nations has recognized the importance of taking action to reduce climate change. It developed an effort to reduce the amount of greenhouse gas emissions from deforestation and **degradation** in developing countries. This effort is known as REDD (**R**educe **e**missions from **d**eforestation and forest **d**egradation). In December 2010, the United Nations took another step forward. The new effort, known as REDD+, includes the following actions.

REDD+

Reduce emissions from deforestation

Reduce emissions from forest degradation

Manage forests sustainably

Conserve the carbon contained in forests

Enhance the carbon contained in forests

Under REDD+, developing countries will receive money if they successfully complete one or more of these actions. This money can be used to cover some of their costs.

The United Nations views REDD+ as an investment that will help countries to reduce the impact of climate change.

Recognizing that the carbon held on Earth within forests helps to address climate change has created a number of opportunities and challenges. People now recognize carbon **sequestration** as a benefit of having forests. This is in addition to other forest benefits that we explored in Inquiry 3. When thought of this way, you can see that by holding carbon, forests provide a service that has value. A government or a business may decide that maintaining forests for the carbon they hold is worth more than felling forests for fuelwood, agriculture, or for other reasons.

The United Nations also recognized that when forest managers work sustainably, they help people and forests worldwide adapt to a changing climate. As the climate changes, forest management will play an important role in maintaining the health and wellbeing of the world's citizens.

REFLECTION SECTION:

Countries are beginning to manage some of their forest areas primarily for the protection of soil and water (Inquiry 3). In the same way, do you think countries may begin to manage their forests primarily for the protection of carbon resources? Why or why not?

Look at the list of actions that make up REDD+. Compare the first two with the last three. How are the last three different than the first two?



FACTIVITY:

Two ways to address climate change are to take care of the trees and vegetation we have now and to plant more trees and other plants. Working with your teacher, identify 2 actions that your class can take now to address climate change. You may think of many other actions, such as decreasing the amount of energy you use or writing letters to your community leaders. Set a time line for when these actions will be taken and who will do what.

