I BET YOU DIDN'T KNOW...

Tree restoration - it's now or never

Prof. Dudley Shallcross, PSTT CEO, links **cutting-edge research** with the **principles of primary science**

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Climate change is a pressing issue for all of us and although there are many ways that we could slow down climate change by using *clean energy* (Figure 1), one of the best ways is to restore areas that were once populated by trees. Trees absorb carbon dioxide (CO_2), one of the principal *greenhouse gases* in the atmosphere. These gases are essential to keep the planet's surface temperature habitable. Without any greenhouse gases, the average temperature would be -18°C, i.e. the Earth would be covered in ice and we would have a 'snowball Earth'. However, for the last 170 years, the amount of carbon dioxide in the Earth's atmosphere has increased by 48% above the pre-industrial levels found in 1850, largely due to humans burning *fossil fuels* (Figure 2). Increasing the amount of greenhouse gases acts like extra layers of blanket and will lead to a warming of the Earth's surface (Figure 3).

Figure 1. Examples of clean energy sources.
(A) wind turbines, (B) solar panels, (C) a hydroelectric dam, (D) a geothermal power plant.

Figure 2. Monthly measurements of carbon dioxide levels (average seasonal cycle removed) measured at Mauna Loa Observatory, Hawaii from 2005 to the present day. Note: pre-industrial levels were approximately 280 parts per million.

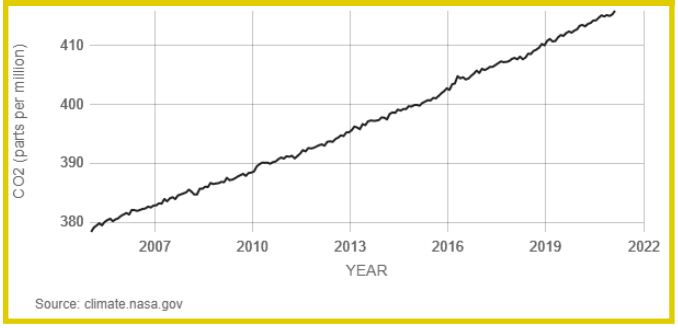

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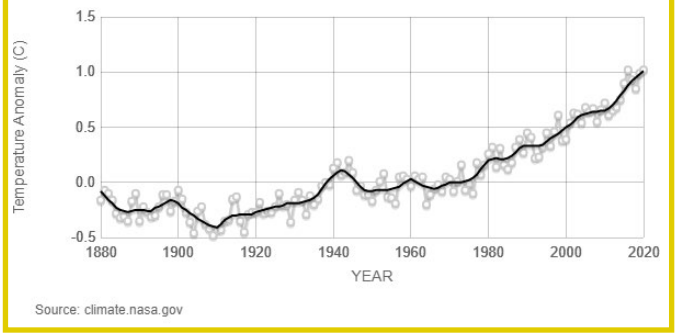
Figure 3. This graph shows the change in global surface temperature relative to 1951-1980 average temperatures. Nineteen of the warmest years (except for 1998) have occurred since 2000.



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By increasing the number of trees, climate change can be limited (i.e. we can prevent the warming from becoming too large). In a recent paper by Jean-Francois Bastin and colleagues, they calculated what the 'tree restoration potential' would be under the current climate conditions, i.e. how many more trees we could grow now to slow down climate change, and how many more trees we could grow in 2050 if the climate warms as expected.

These are some questions that we may like to discuss with children in class:

- What do trees need to grow?
- Why can we not plant trees everywhere on the surface of the Earth?
- Why are some areas of the Earth deserts where no growth can occur?
- What information would we need to be able to work out how many trees we could plant in our own local environment?
- Could we plant any type of tree? If not, why not?
- Are some tree types better than others for absorbing carbon dioxide?

Jean-Francois and his team estimate that 4.4 billion hectares of land can support tree growth under existing climate conditions. This is an increase of about 1.6 billion hectares from the 2.8 billion hectares of land that support trees now. However, not all that extra land can be used. Some land is needed to grow food and some to support human development (such as building new houses and roads). The scientists estimate that about 0.9 billion hectares could be used to grow trees in addition to what is already in place (outside croplands and urban areas).

Where in the world are the areas where tree restoration has the greatest potential?

These researchers estimate that over 50% of the new growth needed (0.48 billion hectares) could be established in just six countries (Table 1). The amount of additional carbon dioxide that is emitted into the atmosphere is often referred to simply as carbon. You may have heard the expression 'carbon footprint'. Scientists measure amounts of carbon in huge quantities – gigatons of carbon (GtC). If we restored these forests, it would remove approximately 205 GtC from the atmosphere, a lot of carbon that would go a long way to off-setting climate change (humans have already added about 300 GtC to the atmosphere since 1850). However, if we wait until 2050 before addressing the issue, and using estimates from computer models about the climate at that time, the amount of land area that could be used to grow trees will have reduced from the current levels by 0.22 billion hectares, equivalent to around 46 GtC, and we won't be able to restore these lands to growing trees. Certain regions will become warmer and better for tree growth but most importantly, in tropical regions, where growth is most rapid now, it will become less efficient because the climate will change (notably becoming much hotter and too hot for tree growth).

The scientists who undertook this study have concluded, therefore, that tree restoration is probably the most effective way to offset climate change, but we need to act now and not wait.

Table 1. Area available for reforestation. These countries could provide half of the 900 million hectares needed.

Country	Area available for new forest (million hectares)
Russia	151
United States	102
Canada	78.4
Australia	58
Brazil	49.7
China	40.2

Useful website - see Trees for Cities
www.treesforcities.org *last accessed 30.03.21*

GLOSSARY

clean energy
energy that comes from renewable resources that do not pollute the atmosphere when used, e.g. solar energy, wind energy, hydro energy, tidal energy and geothermal energy

climate change
a long-term change in the average weather patterns on Earth

fossil fuels
fuels containing carbon that have been created by natural processes, such as decomposing plants and animals, over millions of years, e.g. coal, crude oil, natural gas and petrol

greenhouse gases
gases in the Earth's atmosphere that trap heat and contribute to global warming. They let sunlight pass through the atmosphere, but they prevent the heat that the sunlight brings from leaving the atmosphere, e.g. water vapour, carbon dioxide, methane

hectare
a square with sides of 100 m in length, i.e. the area of the square is 10,000 m^2

The paper that inspired this work was:

The global tree restoration potential.

By Jean-Francois Bastin,[1] Yelena Finegold,[2] Claude Garcia,[3,4] Danilo Mollicone,[2] Marcelo Rezende,[2] Devin Routh,[1] Constantin M. Zohner,[1] Thomas W. Crowther.[1]

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The researchers all speak different languages, so how do they communicate with each other?