08-04
Proceedings of 24th Kerala Science Congress, 29-31 January 2012, RRII, Kottayam, pp. 459-461

Trees are not the answer to climate change

P. R. Satheesh and James Jacob
Rubber Research Institute of India, Kottayam-686 009, Kerala, India

INTRODUCTION

There is convincing evidence linking accumulation of anthropogenically emitted CO_2 and other greenhouse gases (GHGs) in the atmosphere with global warming and climate change that we are currently witnessing (IPCC 2007). While a few GHGs are naturally occurring, others are man-made as a result of large scale industrialization. While anthropogenic emission of all GHGs has been increasing over the years, atmospheric CO_2 concentration has registered the highest increase and thus contributed the maximum to climate change. Before industrialization, the atmospheric CO_2 concentration remained more or less constant at about 280 ppm for many centuries, but over the past one and a half century, this rapidly increased to well over 380 ppm (Fig.1). Fossil fuel combustion and cement manufacture which dramatically increased with industrialization were responsible for more than 75% of the increase in atmospheric CO_2 concentration (*EIA*, 2011).

During summer, the CO_2 concentration in the atmosphere is low reflecting the high rate of global photosynthesis (Gore, 2006). The low temperature during winter inhibits photosynthesis both on the land and in the oceans and this results in the atmospheric CO_2 concentration going up. Thus, accumulation of CO_2 in the atmosphere is a dynamic function of the balance between the amount of CO_2 emitted by the world and the total amount of CO_2 sequestered by the planet (through photosynthesis) during a given period of time.

Atmospheric CO_2 concentration = CO_2 Emission – CO_2 sequestration

From the above equation, it is evident that growing more trees will reduce atmospheric CO_2 concentration. Forest departments in several Indian states have taken up massive tree planting programmes with the slogan that trees are the answer to global climate change. While growing trees is a good idea and tree planting programme should continue, we show in the present study that even converting the whole planet into a forest will not be sufficient to prevent the current rate of build up of CO_2 in the atmosphere.

MATERIALS AND METHODS

Long term data on CO_2 emission and atmospheric CO_2 concentration were obtained from authentic published sources (Carbon dioxide Information Analysis Center and the World Resource Institute). Data on terrestrial and ocean CO_2 fluxes were taken from the fourth assessment report (AR4) of the Intergovernmental Panel on Climate Change (IPCC, 2007).

RESULTS AND CONCLUSION

Linear regression analysis shows that the annual rate of increase in CO_2 emission between 1950 and 2008 was 438.01 Mt CO_2 per year (R^2 = 99%) and the atmospheric CO_2 concentration increased at the rate of 1.30 ppm per year which is equivalent to 10151.06 Mt CO_2 per year (R^2 = 97%) (Fig.2). Between 1950 and 2008, CO_2 emission (including fossil fuel combustion and land use changes) increased from 9450 Mt to 34939 Mt. During the same period, atmospheric CO_2 increased from 311 ppm to 386 ppm (Fig. 2). The increase in CO_2 emission was 270% while atmospheric CO_2 concentration increased only to the tune of 24%. Despite the huge increase in CO_2 emission, the atmospheric CO_2 did not build up to the same extent and this indicates that the amount of CO_2 sequestered by the planet must have increased at a rate greater than the rate at which CO_2 build up increased between 1950 and 2008.

Terrestrial removal of CO_2 during 2000-2005 was 0.9 Gt C per year (IPCC, 2007) and this is equal to 3303.0 Mt CO_2 per year. Total vegetation area on earth surface is about 15000 M ha. From this we

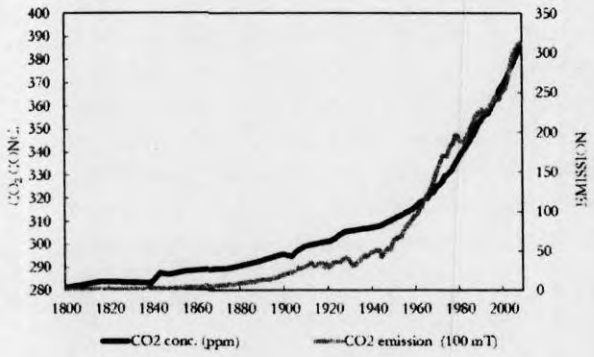

Fig. 1. Graph showing the change in CO_2 emission and concentration in the atmosphere form the year 1800 to 2008.

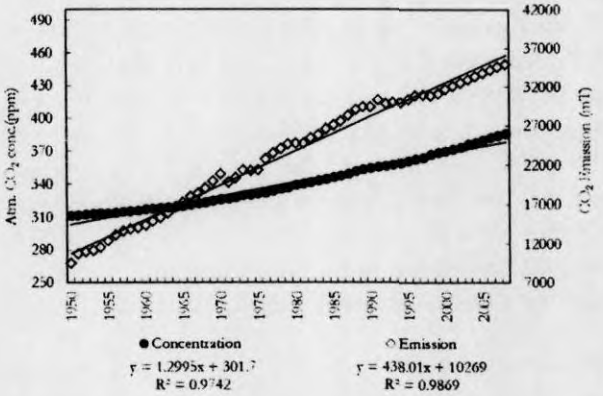

Fig. 2. Rate of increase in the world CO_2 emission and atmospheric CO_2 concentration between the period 1950 and 2008.

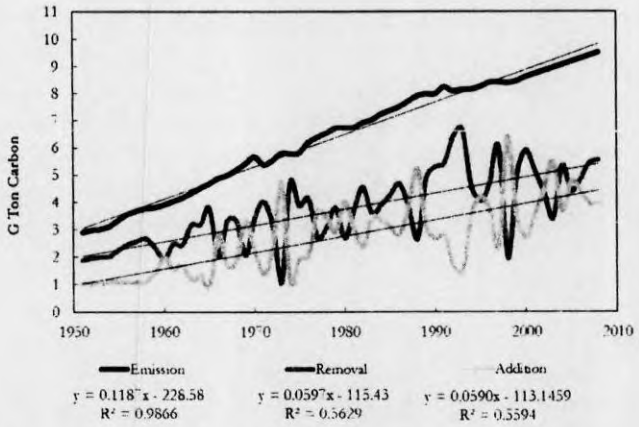

Fig. 3. Graph showing the global carbon balance sheet.

calculated the terrestrial carbon fixation rate which comes to 220 x 10^9 mT CO_2 per hectare per year. At this rate, we need an additional land area of around 46141.0 M ha for planting trees so as to fully offset the current rate of increase in atmospheric CO_2 concentration (1.30 ppm per year). This is equal to the terrestrial vegetation area of three planets.

From the emission and concentration data of CO_2 obtained from published sources, we calculated the amount of CO_2 sequestered as the difference between the former two. The rate of CO_2 emission (including land use change) from 1950-2008 was 0.12 Gt C per year. The rate of removal of CO_2 from the atmosphere (including land and ocean sinks of CO_2) and the rate of addition of CO_2 to the atmosphere were identical (0.06 Gt C/year) (Fig 3). The rate of emission was much greater than the rate removal and the difference was 0.06 Gt C per year. This indicates that even if we take the sequestration capacity of the land and ocean together, we will still require one more additional planet to remove the current rate of CO_2 emission to maintain equilibrium between emission and removal and thus keep the atmospheric CO_2 concentration at a stabilized level.

Thus we show that at the present rate of anthropogenic CO_2 emission, our planet will not be able to sequester enough CO_2 to prevent further rise in its concentration in the atmosphere. This can be achieved only by deliberate reduction in the amount of anthropogenic CO_2 emission into the atmosphere.

REFERENCES

EIA. (2011). *Annual Energy Review 2010.* U.S. Energy Information Administration, Tables 1.3, 2.1b-2.1f, 10.3, and 10.4.

Gore Albert (2006). An Inconvenient Truth. "An Update with Former U.S. Vice-President Al Gore" (DVD). Paramount Pictures. 2006-11-21.

IPCC. (2007). Fourth Assessment Report (AR4),Climate Change 2007: The Physical Science Basis.Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate C hange. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.