the National Rural Employment Guarantee Act. The remaining plantations can then function normally. The restored landscape can be opened up for ecotourism that could generate revenue to offset losses arising from biodiversity restoration. The issues arising out of plantation abandonment are complex and need to be studied in greater detail. There are no win-win situations, but a working compromise needs to be made where both workers' livelihoods and ecological stability of the landscapes are met.

1. FAO, 2011; http://www.fao.org/economic/ess/ess-publications/ess-yearbook/ess-yearbook2010/yearbook2010-production/en/
2. Neilson, J. and Pritchard, B., *Value Chain Struggles: Institutions and Governance in the Plantation Districts of South India*, Wiley-Blackwell, West Sussex, UK, 2009.
3. Tea board, 2012; http://www.teaboard.gov.in/pdf/stat/Growers%20&%20Area%-20under%20Tea.pdf
4. Kumara, H. N., Kumar, A. M., Sharma, A. K., Sushma, H. S., Singh, M. and Singh, M., *Curr. Sci.*, 2004, **87**, 1282–1287.
5. Raman, T. R. S. and Divya, M., *Soc. Change*, 2003, **33**, 129–141.
6. Chetana, H. C. and Ganesh, T., *J. Trop. Ecol.*, 2012, **28**, 187–197.

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A logical approach for worldwide carbon reduction

The proceedings of the Copenhagen meeting have saddened us. Adopting a political eye, each country wants to do the least and at the least cost. For this reason, conventions like the Kyoto Protocol and Copenhagen Accord do not have much of a future; they are only good as interim measures.

Carbon has been building up in the atmosphere. Presently, much emphasis is given on mitigation at 'source'. But a substantial amount of carbon still remains unabsorbed and enters the atmosphere, causing global warming. This is where 'sinks' come in. Our objective should be to maintain a balance between the worldwide sources and sinks of CO_2 so that further build-up stops. This has to be our first guiding principle to avoid global warming and prevent climate change[1].

Obviously, the world does not have enough sinks (forests, trees, oceans, freshwater bodies, wetlands) to take care of present-day emissions, as otherwise CO_2 build-up would not be occurring. I submit that there is an equally strong case for increasing sinks as there is for reducing sources. However, we must first protect existing sinks.

The first step is to stop deforestation. It is estimated that this would reduce CO_2 by ~20%. The REDD programme, instituted in 2008 by the UN for reducing emissions from deforestation and forest degradation in developing countries, evidently admits that we need both reduction in carbon emission sources and increase in sinks to absorb the carbon. We need both equally and should therefore be willing to pay for both. In fact, we are already making payments, through carbon credits, to secure rights over newly developed dedicated forests. Now, we have to make payments under the REDD scheme for saving our existing forests.

Many more such transactions have to take place and the concept has to be formally incorporated into the carbon-reduction strategy of every country (Figure 1). Ideally, in future, the world's countries could be told that each country can produce as much CO_2 as it can conveniently absorb through its own sinks as well as those available to it on lease basis from other countries.

The carbon absorption capacity of sinks in warmer regions is much higher than those in colder regions. A tree located in a cold or temperate climate

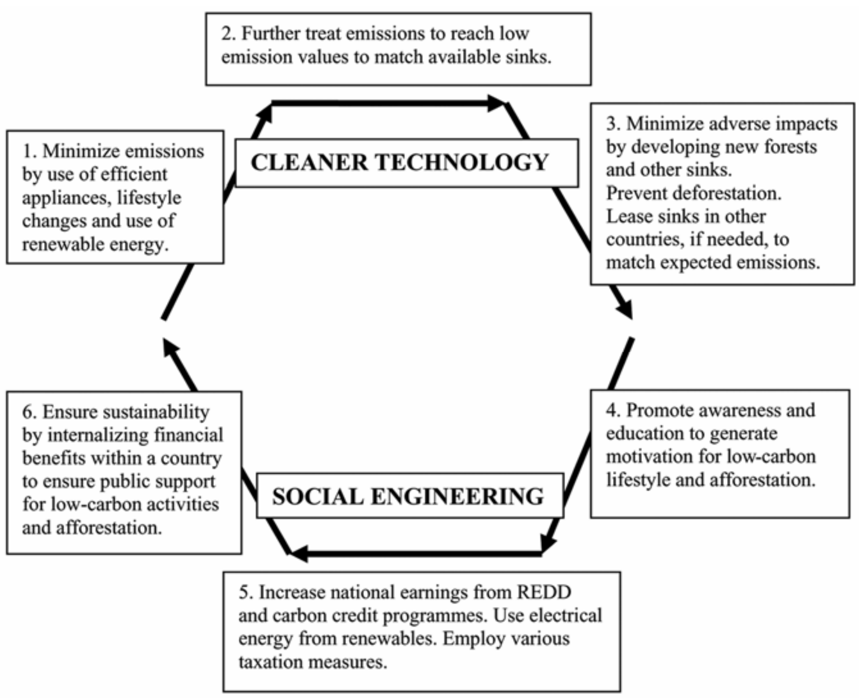

Figure 1. The carbon-neutral wheel.

zone (from where we presently get much of our data) is said to absorb only ~1 tonne of CO_2 during its lifetime, whereas a tree in a warm country (where photosynthesis occurs faster and for a longer duration per year), absorbs ~2–2.5 tonnes. If more studies could show this to be true, it means that developing countries in warmer climates should earn twice as much as they do now. This would tempt them to develop forests and other sinks. We also need to see if large and slow-moving sinks, on which human interference is fairly minimal, can be expanded.

But will this balancing of sources and sinks be sustainable in the long run? For this, we need to practice social engineering. The system must generate new funds and these funds should be used to produce income for the local people, so that they are motivated to ensure its sustainability. This has to be our second guiding principle.

So our mantra should be: Give equal importance to both sources and sinks of carbon, and make sure the people earn something from it all. The main advantage of the proposed approach is that each country can exploit its own resources as best as it can because equal emphasis is given to carbon mitigation and absorption. Countries that are richer in technology can concentrate on source reduction while warmer countries, for example, can concentrate on their forests and other sinks. All countries – rich, poor, cold and warm – must feel equally involved. It would also make people exercise greater vigilance against deforestation, and promote conservation of water (and wastewater), rainwater harvesting and recharging of groundwater – as water would be in greater demand than ever before. Finally, the system would be robust and sustainable as people would develop a vested interest in its continuation.

1. Arceivala, S. J., *Global Warming and Climate Change*, Indian Environmental Association, Mumbai, 2010.

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The 'living fossil' shola plant community is under threat in upper Nilgiris

The Nilgiri hills, an integral part of the Western Ghats complex, is located between 10°38′–11°49′N lat. and 76°25′–77°15′E long. at the junction of the Eastern and Western Ghats. The altitude in the upper areas of the Nilgiris ranges from 1800 to 2500 m amsl. The Nilgiris is a component of the Western Ghats mountain range in India, which is recognized as one of the hotspots of biological diversity in the world[1]. The Nilgiri Biosphere Reserve (NBR) comprises the whole of Nilgiri District, parts of Coimbatore plains, Mysore plateau consisting of Bandipur National Park, Wyanad Wildlife Sanctuary, Mudumalai Wildlife Sanctuary, Silent Valley National Park and Nilambur plains[2]. The total area of NBR extends over 5520 sq. km. The natural vegetation of this region is classified as southern montane wet temperate forests and montane grasslands.

The closed evergreen forest, called the shola, occurs above 1700 m in patches in the higher hills of South India in the Nilgiris, Annamalai and Palani hills. Sholas are patches of stunted evergreen tropical montane forests which attain a low height of about 16–20 m. These forests have high ecological significance in protecting the head waters of rivers by holding up of water received by precipitation like a sponge, thus preventing rapid run-off. They are considered as a relict of an evergreen forest climax, pushed back to damper sites, by the combined effects of fire, frost[3], grazing, clearance for agriculture and the prevention of regeneration by rapid erosion of the soil. This shrinking ecosystem is home to several rare, endangered and endemic species, many of which face danger of extinction[4]. This non-regenerating and fast-receding shola forest is a dying community, more appropriately called a 'living fossil' community[5]. Most shola patches in the non-protected areas have been fragmented, degraded and encroached. Although most of the shola patches in the Nilgiris are naturally small, there is considerable human-induced fragmentation mainly in the vicinity of the settlements. At present, this floristically and ecologically important ecosystem is facing a new threat from the invasive exotic weed *Passiflora mollissima* (H.B.K.) Bailey.

Shola forests in the Nilgiris are highly species-rich when compared with other tropical rain forests. A common life-form which is poorly represented are the climbers, particularly lianas or woody wines. There are several native climbers found in the shola forests, such as *Clematis wightianus*, *Parthenocissus neilgherrensis*, *Rubia cordifolia* and *Tylophora pauciflora* which seldom reach the top of the canopy.

P. mollissima, a woody wine from the Andean highlands (2000–3600 m) of South America, has successfully invaded in the upper sholas of the Nilgiris, often climbing to heights of 20 m or more

Figure 1. Shola tree (*Syzygium calophyllifolium*) completely covered with *Passiflora mollissima*.