



Carbon cycle management with increased photo-synthesis and long-term sinks

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Energy related emissions are just over 5 per cent of CO₂ flows into and out of the atmosphere. This suggests that mitigation investment in the heavily capitalised energy sector is likely to be less cost-effective than investment designed to increase photo-synthesis on under-capitalised land.

Managing land so as to substantially increase the total amount of terrestrial photosynthesis, and hence the supply of biomass, raises concerns related to the human 'ecological footprint'. These neglect the reality that natural ecosystems do not maximise the sustainable productivity of the land where they have evolved. Such simple investments as stock-proof fencing to prevent animals destroying crops and plantations at the seedling stage can improve on nature. Carbon fixing soil amendment yields environmental benefits, including enhanced fertility and water retention.

Efficient management of part of the land, in lieu of widespread unsustainable traditional land management, can enable natural bio-diversity to flourish in conservation areas. Such efficient management can yield food and forestry products co-produced with biomass on existing cropland. Alternatively (and hence additionally) estimates of land requirements to effectively mitigate all current anthropogenic emissions of CO₂ fall well short of the ~1.5Gha of potential arable land (IPCC 2001) that is not in use – there is no shortage of land but of investment in land. Additional biomass can be used in lieu of fossil fuel as the basis for bio-fuels and bio-electricity; its carbon content, in the form of bio-char ("charcoal") can be used for soil amendment with 5K-yr half life; or it can be used as wood, or advanced materials such as carbon fibre, in long-lived artefacts.

On plausible technological assumptions and oil price projections, CO₂ reductions got from better use of land, and of products of the land, can have low or even negative cost,

taking account of added value from co-products. Done on a large enough scale, such better land use can contribute to rapid reductions in CO₂ levels if needed (~30ppm per decade) e.g. through bio-energy with CO₂ sequestration, involving the extra cost of CO₂ separation, compression and safe storage (CCS).

This good news was considered in the context of potential abrupt climate change (ACC) at a recent expert workshop (www.accstrategy.org). No scenario was presented in which this threat was imminent, but it was recognised that climate models are more stable than the paleo-climatic record, that a failure of the THC might prove to be irreversible, and that processes of terrestrial ice loss, sea-ice variability, methane release and climate induced reduction of photosynthesis could precipitate imminent ACC, for which the thresholds and triggers are currently poorly understood. In particular, there may be a limit to the heat burden that it is safe to inject into the oceans, which would mean that there is a time limit to the elevation of GHG levels above pre-industrial (this implies a misspecification of the ultimate objective at Article 2 of the Rio Convention).

For such a limit to be met, carbon management needs to be capable of significant annual net absorption of CO₂ from the atmosphere. This cannot be achieved by reliance on the zero-emissions energy technologies that are promoted through the emphasis on domestic action built in to the Kyoto Protocol. At best those result in an asymptotic approach to the enhanced level in the natural sinks. A negative emissions system is needed that can drive a linear downward path in the CO₂ level, e.g. by growing additional biomass and using it in ways that store part of its carbon content long term.

The conclusion of the workshop was that policymakers should be urged to stimulate the growth of a global bioenergy market, with world trade (mainly “South-North” trade) in liquid bio-fuels such as ethanol and synthetic (e.g. Fischer Tropsch) bio-diesel.