urban agriculture AUSTRALIA

Can urban agriculture help bio-sequester carbon in soils?

Carbon is often in the news. The undeniable scientific reality is that atmospheric CO_2 levels have been rising abnormally for at least 50 years and risk serious disruptions to our climate, our wellbeing and our future. What is the problem, and how can urban agriculture help to address it?

The history of carbon

Carbon is one of 96 natural elements that make up our planet. It comprises 4% of the total planetary mass, and has served as the building block for all bio-systems since life began on Earth 3.8 billion years ago.

Prior to this, as on Mars and Venus, Earth's carbon would largely have been in the atmosphere in the form of methane and carbon dioxide (CO_2). Some of these gases would have been absorbed by oceans to form a range of simple carbon compounds.

Only on Earth did the concentration of these compounds, mineral nutrients and electrical potentials in cells give rise to life as we know it. Carbon compounds were continuously formed into more complex organic compounds, the carbon-based building blocks of all life.

Over the next 3 billion years, these processes enabled the biological draw down of millions of billions of tonnes of carbon from the then atmosphere – into calcium carbonate. This formed the Earth's vast chalk, limestone and coral deposits and created an oxygen rich atmosphere such as we have today.

From about 420 million years ago, carbon draw down was reinforced by the evolution of life on land and the formation of soils. Soils were formed from mixtures of rock fragments and detritus from the micro-organisms and plants that rapidly colonized the 30% of the Earth's surface that is land. Above ground, photosynthesis by plants fixed carbon as **biomass**. Below ground, **bio-sequestration** by soil fungi turned biomass into **humates** (stable soil carbon). Some humates were transformed into fossil fuels. These processes may have involved 40,000 billion tonnes of fixed carbon.

Via these new processes, the CO_2 level in the atmosphere decreased further - from 7,000 to as low as 100 parts per million (ppm).

Our bio-sequestration challenge

Over the past 10,000 years as agriculture and then industrial societies expanded, we have massively oxidized (burnt) these stores of fixed carbon by:

- Clearing and burning some 70% of Earth's primary forest and wetlands.
- Overgrazing, cultivating and exposing over 7 billion ha of soil.
- Creating 5 billion ha of man-made desert.

- Oxidizing limestone for cement
- Over the past 200 but particularly in the past 60 years: mining and burning fossil fuels on a massive scale.

These activities have oxidized up to 20,000 billion tonnes of carbon, and are responsible for the recent abnormal increase in atmospheric CO_2 levels from 280 to now 400 ppm.

Moreover, as we cleared the forests and degraded the soils we impaired the hydrological cycles that are critical to sustaining the natural draw down of carbon, and massively damaged the Earth's natural capacity to bio-sequester it.

How can we fix the problem?

Humans currently emit some 10 billion tonnes of carbon each year. Our residual bio-systems bio-sequester but also emit some 100 billion tonnes per year. It follows that a 10% increase in net bio-sequestration could offset our annual emissions. Half of natural carbon bio-sequestration occurs on land – so a 20% increase in net land-based bio-sequestration would be needed to offset our emissions. However, to return atmospheric CO_2 levels below 350 ppm to secure our safe climate we need to draw down not only our current but also our past 'heritage' emissions at a rate of some 20 billion tonnes per year. To do this we would need to increase our net land-based bio-sequestration rates by 40% above current levels.

We can readily do this by enhancing (a) the area and rate of biomass production, and (b) the bio-sequestration of some of this into stable biomass and soil carbon.

The area and rate of biomass production can be increased by regenerating our 5 billion ha of man-made desert, and by integrating forests into much of our 5 billion ha of rangelands.

The rate of bio-sequestration of carbon back into soils can be increased through ecological farming practices. These methods can bio-sequester up to 10 tonnes/ha/year while producing more productive and resilient crops. In contrast, our current land management practices are oxidising up to 5 tonnes of carbon/ha/year.

This calls for the urgent widespread adoption of regenerative land management. Only by massively drawing down the carbon we have put into the atmosphere can we hope to secure our climate and essential bio-systems.

How urban agriculture can help

Urban agriculture has a critical role to play in bringing about this transition, by:

- Raising awareness of the direct connections between our food, health, climate and future.
- Producing healthy local food with lower carbon inputs to replace industrial food with high carbon inputs.
- Efficiently recycling organic wastes into soil humates.

The greatest contribution urban agriculture can make to carbon bio-sequestration is in returning the essential mineral nutrients exported from farmlands in food. Efficient mechanisms exist for converting nutrients from urban wastes into stock supplements and bio-fertilizers, and returning them to rural soils.

Further information on this topic

Soils, an Australian Viewpoint (CSIRO, 1983)

Australian Soils and Landscapes, by N McKenzie et al (CSIRO, 2004)

Permaculture, a Designer's Manual, by Bill Mollison (Tagari Publications, 1988)

www.soilsforlife.org.au