emissionstrading@climatechange.gov.au

SUBMISSION TO CARBON POLLUTION REDUCTION SCHEME - GREEN PAPER

55, *Kookaburra Park Eco Village*

Gin Gin

Queensland 4671

Email colinaustin@bigpond.com

Name/s of author/s:
(complete this and note confidentiality statement below)

Colin Austin

Xuilan Tang

Date:*29 August 2008)*

Confidentiality statement:

All submissions will be treated as public documents, unless the author of the submission clearly indicates the contrary by marking all or part of the submission as 'confidential'. Public submissions may be published in full on the website, including any personal information of authors and/or other third parties contained in the submission. If your submission contains the personal information of any third party individuals, please indicate on the cover of your submission if they have not consented to the publication of their information. A request made under the *Freedom of Information Act 1982* for access to a submission marked confidential will be determined in accordance with that Act.

I **do not** want this submission to be treated as **confidential** or **anonymous**

Colin Austin
55, Kookaburra Park Eco Village
Gin Gin
Queensland 4671

www.waterright.com.au
colinaustin@bigpond.com
Tel 07 4157 2278
mob 041 5851542

Monday, September 01, 2008

Green Paper Submissions
Department of Climate Change
GPO Box 854
Canberra Act 2601

Dear Sirs,

We have pleasure in presenting our contribution to the Green Paper submission.

This submission shows how Australia can help rapidly developing countries with a particular emphasis on China to achieve carbon balance and commit to future international protocols by adopting the widely misunderstood technology of capturing carbon in the soil.

We have the technology. It has been developed over thirty years. It consists of a method of harvesting and controlling water to encourage micro biological activity which bonds carbon into the soil. The technology was originally developed to provide reliable food in regions with an arid and variable climate. This ability to harvest and capture water and carbon together has the potential to be a major factor in the fight against global warming. Widespread adoption in these countries would have a far greater impact than reducing Australian emission.

If we as a Nation want to protect ourselves from emissions we have to be far more proactive than simply cutting our own emissions, we need to be part of a global strategy. There is inevitably an additional cost in absorbing carbon in the soil hence a global trading scheme including carbon capture in the soil is essential as a way of providing a financial incentive to growers around the world.

Obviously we need to manage our own emission to gain international credibility. But we must do more than that. We must work with these developing countries, particularly China to help them establish the technology in their countries. We also to work with them to ensure that carbon capture in the soil is included in the next post Kyoto international agreement.

Many dedicated people, often working with international NGO's, have shown dedication in introducing this technology to the poorer countries by promoting the benefits of improved water and nutrient holding capacity of the soil to increase food production.

However this is not enough to make a significant impact on global warming. It requires international action at the Government level for both technology transfer and implementing the international trading scheme to provide the financial incentive to growers. Australia as a wealthy arid country, a major exporter of both food and coal, with a strong technical capability and a stable, and progressive and international thinking Government is the natural leader.

Whatever action we take to achieve carbon balance within Australia is almost irrelevant on a global scale. Our fate with global warming depends on what happens in China and the many other developing countries. The proposals in this submission are not based on some woolly concepts of the world working together in peace and harmony. It in our self interests and is probably the only way of protecting this country from the dangers of global warming.

We now need the political mechanism to achieve these twin aims adoption by technology transfer and an international trading agreement.

It would be a historic day if Kevin Rudd, our Mandarin speaking Prime Minister were to send a memo to China saying

- we have the technology to help China achieve a carbon balance,
- we want to work with China to introduce this technology into China and
- we want to work together to have this technology accepted into the next post Kyoto agreement.

This day would be a turning point in the long term battle for a sustainable planet and open up the door for the grunt work to begin.

I can anticipate the sea of comments on the green paper; I just hope that the global importance of this submission is not lost in either this either this sea or in the technical details of this submission.

This submission is not intended to be a manual on the technology; we are willing to provide the further technical details on request. As we are involved in significant travel we suggest that communication should be by email to colinaustin@bigpond.com.

I sign this letter on behalf of the team members who have put so much effort into project.

Yours faithfully

Colin Austin

Response to Green Paper on Climate Change

28th August 2008

About the Authors

Colin Austin is one of Australia leading innovators, having pioneered the Moldlfow technology which is now accepted world wide with his company becoming one of Australia leading exporters of technical software. He has been involved with sustainable food production throughout his life leading to the development of the wicking bed system for carbon capture.

Xuilan Tang is a Chinese National and a Medical Doctor starting her experiences in the remote Xinjiang area during the Cultural Revolution through to becoming a surgeon in the Chinese medical system. She is now in Australia studying the carbon capture and wicking bed technology.

Part 1 Climate change – a global problem

The green paper makes the dangers we face very clear; - the disruption to our agricultural system, the damage to the Murray Darling Basin, the Barrier reef, water supplies, coastal properties and potential storm damage.

Various groups have argued that Australia's contribution to global warming is miniscule and we should not jeopardize our industries by schemes which will damage our economy until such time as developing countries agree to cut their emissions.

It is true that global warming in Australia is not caused by emissions from Australia; it is currently the results of the accumulation of emissions from the developed countries over many years but in future will be dominated by the emissions from the developing countries with China playing the lead role

In our submission we look at what Australia can do to assist the developing countries to manage their carbon balances. We focus on China as the lead country and for reason of personal expertise.

I started my visits to China some 25 years ago introducing high technology to that country and have learned a great deal about how a country like China adapts to new technology. Also my co-author Xuilan Tang is a Chinese national, a medical doctor who at the start of her career was swept up by the Cultural Revolution and provided medical services in remote mountain areas before moving to the sophistication of the Chinese medical system and so has first hand experience of the daunting social changes in China.

I am going to focus on China for the simple reason that this is the country where we have most experience.

I am sure other contributors with greater expertise in other developing countries could expand this submission to these countries but the conclusions are likely to be very similar. Even countries we think of as well down the list of development are still increasing emissions. I have visited such countries as Ethiopia to find modern high tech production facilities.

While I refer in this submission specifically to China in reality it applies to the whole of the developing world.

This section, Part 1 gives a summary of our argument.

In Part 2 we examine in more detail the pressures operating within Chinese society which affect its possible future actions.

In Part 3 we look at a technology which could totally change the equation, namely capturing carbon in the soil.

China the key to protecting Australia from Global warming

China is under pressures from two sources to take early action on global warming. Firstly China itself is particularly sensitive to global warming with large areas of the North subject to desertification while the South is exposed to major flood and storm damage. Secondly during the early phase of its industrial explosion there was minimal environmental control resulting in major environmental damage, particularly to its water resources, necessitating major remedial action and sensitivity to the environment.

This creates an atmosphere willing to accept change.

On the other hand there are major obstacles. The structure of Chinese society makes it singularly difficult for the Chinese Government to reduce energy consumption. China population is not economically homogenous. It comprises a relatively affluent middle class in the cities with a large poverty stricken rural population.

Despite their poverty the older generation makes sacrifices to send their child to University or for further education. This causes a mass migration to the cities of well educated youth looking for economic advancement so they can support their aging parents, a tradition locked into Chinese culture.

The net results it that however much the Chinese Government may wish to be part of a carbon reduction protocol it is virtually impossible for it do so within the current Kyoto style protocol. Even if China was pressurized into a next generation Kyoto style emission reduction it would be virtually impossible for it to keep its pledges.

Without some major new input to the equation we have to accept that emissions from the developing countries are not going to be cut, they are going to continue to grow at what could be an increasing rate.

In the affluent West we may not like this but this is the brutal reality

Solution; - assist China to absorb carbon

Technology for capturing carbon in the soil would allow China to reduce its net emissions and become part of the international protocol.

The Kyoto protocol has unfortunately been very silent on this issue. Essentially cutting off an alternative route for achieving a carbon balance has prevented the developing countries such as China from being part of the Kyoto protocol.

With hind sight, as China's emissions continue to grow, this could turn out to be a major global tragedy.

This is not the results of some perverse attitude among the negotiators but is more the results of the failure of the scientific community to provide a broad and readable picture of the technology of carbon absorption in the soil.

Revolving carbon

Let me try and summarize the key points. The total carbon absorbed by plants is some thirty times all man made emissions (1). I was amazed when I first read this, it sounded almost too good to be true, so where is the catch. The bulk of the carbon absorbed by the plants simply re-enters the atmosphere without being captured in the soil. It is like a huge revolving mass of carbon which is simply circulating from the atmosphere into the plants then back into the atmosphere.

One of the key causes is the powerful combination of oxygen and UV light which breaks down the complex organic molecules into gasses. However common types of microbiological activity also return carbon to the atmosphere.

For this reason there is a widely held view that carbon capture into the soil is ineffective.

Science may point out that the carbon in the coal and oil we are burning, and the even larger volume of carbon in the soil in the Savanna belts around the world originated from carbon dioxide in the air which has been trapped by plants. However they point out that this has required very specific conditions, particularly a high water content and has happened over millions of years.

Ted Nield's book Supercontinent Ten billion years in the life our planet (2) is a highly readable book which is the story of how science developed its understanding of continental drift. This story includes a discussion of climate, carbon dioxide and oxygen levels and the formation of coal, oil and natural gas.

It would be impossible to read this book without realizing the role that plants have played in the capture of carbon and that certain climatic conditions particularly water content is crucial to carbon capture. As he points out a high water table is the essential ingredient for the formation of coal, under drier conditions the organic matter will simply re-enter the atmosphere.

Science will also point out that simply mixing organic matter with soil does not lock the carbon in place, rather it gives a mixture in which the organic material is prone to removal by either oxidation, certain types of micro-biological action or simply being washed out of the soil.

Understandably this has led to the widespread, but inaccurate, view that carbon capture into the soil is not practical.

In Part 3 we show that it does not have to be this way. It is possible to change growing practices, using a wicking bed system, so that carbon is locked into the soil giving a way for China and the developing countries to achieve carbon balance.

These techniques require both initial training and ongoing additional labor. Developed countries are often short of labor but developing countries have a pool of under employed labor and for countries like China it would be a boon to have this labor productively employed rather than the mass migration to the cities.

But growers are not going to increase their workload and labor cost without being paid. It is critical that carbon capture in the soil is incorporated into the international carbon protocol and Governments set up the required technology transfer schemes.

The greatest contribution Australia can make to the carbon challenge is to assist these developing countries with technology to help them absorb carbon and to join the international protocols.

Of course we must get our own house in order first, without that we will have no standing in the international community, but that is not enough we have to do much more.

If we really are sincere about protecting our country from damage from Global warming we must address this issue of the rapidly changing scenario in the developing countries.

The theme of my argument is that Australia could make major contribution to these countries by providing technology which could enable them to modify their agricultural system to absorb large quantities of atmospheric carbon.

Changing International protocols

The original Kyoto protocol failed to address the issue of carbon absorption in the soil. The developing countries are far more likely to join the next round if they can see that there is a practical route for them to achieve real success in managing their carbon emission by changing their agricultural practices.

There is considerable misconception about carbon absorption in the soil. There is a clear role for Australia to play in presenting workable methodologies to these countries to gain their support in these forthcoming negotiations.

Currently the message coming from the scientific community is mixed and contentious and certainly it is easy to gain the impression that techniques such as low till farming (as currently practiced) does not result in carbon absorption. This may have some truth but implies that carbon absorption in the soil is not practical. This may have some truth is specific circumstance but to extrapolate out to the general statement that carbon cannot be effectively captured in the soil is just plain wrong.

Design of a carbon soil capture system

There are many problems to overcome is setting up a carbon soil capture system. Large scale emitters have the size and technology to monitor their emission and enter into complex contracts. By contrast the growers who would implement a carbon soil capture scheme are small operators with a low level of sophistication. They will need help in monitoring the amount of carbon they are absorbing. This requires some form of intermediate operation providing a wholesale - retail service to provide a mechanism for carbon trading and to provide monitoring services to ensure the carbon is actually being captured.

Growers not only need financial rewards for absorbing carbon they need a simple system which they can work. They need information so they can decide whether to be involved and how much carbon they wish to absorb. They need to be able to plan ahead.

While the carbon in the soil can be measured retrospectively growers need to know how much money they are going to earn beforehand so they can plan their business.

My experiences with carbon capture indicate that while there is usually some waste organic material on site this needs to be augmented by additional organic material which can be grown specifically. Alternatively waste material can be purchased externally from other farms. This is generally virtually cost free but can involve storage and transport costs which can be significant.

I therefore envisage that on a large scale many growers would be searching their local areas for sources of waste organic material. This may encourage growers to use grow organic material specifically for carbon capture on otherwise unproductive land.

A simple system is required for trade to occur. I envisage a system using a ready reckoner giving a conversion figure for mass of waste to mass of carbon equivalent captured for the various sources of organic material. This could be one role for the wholesale retail organization who would probably also publish a typical price, excluding transport for the raw material.

The wholesale - retail organization, which I assume would be an operation licensed by the Government, would have the responsibility for monitoring the accuracy of the ready reckoner and supervising the system by spot checking against the actual carbon absorbed based on soil measurement.

The quantity of organic material traded can be readily checked while the grower would have the responsibility of measuring the quantity of organic material produced on his farm.

Such a system is practical and allows growers to plan their business and receive payment for carbon capture.

The price of carbon must be adequate to provide a reasonable return to the grower, but may not need to cover all costs. The grower gets significant benefits from the improvement in the quality of the soil and saving on fertilizer.

Most probably a grower would establish a field rotation scheme in which each year a field is set aside for regeneration and carbon capture, probably with a combination of external organic material and growing a nitrogen fixing green manure crop or the use of sewage. (Adding organic material inevitably leads to a short term nitrogen deficiency).

Secondary effects and overall sustainability

We have seen the damage caused by implementing schemes which no doubt well intentioned and apparently sensible when viewed in isolation have had major detrimental effects. I refer to the secondary harm caused by corn based ethanol production which has caused major food shortages and palm oil production which has resulted in major deforestation.

We therefore have to look at this scheme for soil carbon capture using the wicking bed system to evaluate the possible secondary effects, particularly those of food production and long term sustainability.

There is likely to be a reduction in total area under food production however the productivity of the wicking bed system is far higher than conventional production. We need to evaluate the net effect.

The increase in productivity of the wicking bed system over conventional production depends very much on the base level. A well watered region with a young and nutritious soil, for example areas of the South Island of New Zealand, are likely to show a small increase. However areas with a low rainfall and poor soils, such as much of Australia and Northern China are likely to show a very significant increase.

In my recent experiences in the drought in the dry areas of Queensland the wicking bed is the difference between effective production and no production.

On balance then the overall effect will be a significant increase in food production, particularly in the drier poorer countries.

We should also look at the issue of total sustainability. Global warming is just one indication of how mans' activities are effecting the habitability of our planet.

Modern agriculture is continuously mining carbon and nutrients from the soil. These enter the food chain and are largely disposed of in the sea. While some nutrients can be recovered from fish and sea weed the system is far from being in balance. The deficit is made up from oil based fertilizers.

Many agricultural experts have been highly critical of this system and have been pressurizing for a greater level of recycling. This occurs naturally in the process of carbon soil capture using the wicking bed system.

It therefore seems that carbon capture in the soil has side benefits whose benefits may well exceed the immediate benefits of carbon capture.

Can we help

Xuilan Tang, a Chinese national, is currently studying these techniques in Australia. I have spent my life exposed to sustainable growing practices. We both hope to return to China and introduce the technology to China with the target of its wide spread adoption. We also hope to provide information on how the technology could be incorporated into an international protocol.

This can only be achieved as part of international cooperation organized at a Government to Government level. It is hoped that the importance of this offer in countering Global warming is accepted by the Australian Government and appropriate action taken.

Summary of benefits

Carbon capture into the soil using the wicking bed technology provides a way for developing countries, particularly China, to cut net emissions and to join and meet international protocols on carbon.

Without change future emission from developing countries will be the dominant source of atmospheric carbon. This proposal shows an effective way of protecting Australia from the effects of global warming.

The wicking bed system also provides a way of improving soil quality and recycling waste organic material and improves food security.

Part 2 Why China will dominate future emissions

The birth of a new technology

This section may at first sight not appear to be related to climate change, however the lesson learned on how new technology is developed and society adapts to this new technology is relevant to my overall argument.

Over 35 years ago while lecturing at the RMIT I stumbled across the early micro computer systems and had a vision of how they would radically change my profession of engineering design. I acquired expertise in computer aided engineering and developed a system of plastics mold design based on a computer simulation of how a hot plastic flows into a cold mold, a system now universally recognized as the Moldflow system named after the company I founded.

Initially I focused on introducing this technology to the developed countries of Japan, the USA and Europe. These countries already had an advanced but experienced based technology in this area. I found at first considerable resistance to the introduction of computer aided engineering as this was seen as a threat to the established expertise. However the benefits were eventually recognized with an initially slow incremental adoption.

Introducing technology to China

Having established the technology in the developed countries I then looked at how to introduce this technology to China.

My first investigatory visits to China some twenty five years ago were not at all encouraging. It would be fair to say the whole manufacturing process from product design through manufacture to the final product was simply awful. There was little understanding of the basic principles of design; manufacture was crude with little attention to safety or pollution and the final products were grossly inferior.

However there was a fundamental difference in attitude in China. They realized their limitation in skills and saw computer aided engineering as a way of leapfrogging into advanced technology. My interface was not the older experienced designers of the west but young and enthusiastic even if inexperienced graduates eager to learn.

My factory tours would show a whole raft of modern machinery and technology with groups of engineers struggling with various levels of success to work out how to make use of this advanced technology. Technology adoption in China is not incremental, there is a leap to adopt the latest technology from wherever it is best in the world.

China has a moving front, ahead of the front is an affluent society using the latest technology, behind the front is primitive technology and poverty.

We have to give them the respect for their success. If China decided to adopt the technology of absorbing carbon in the soil they could do so quickly and on a large scale making a significant reduction to the carbon balance. It is in our best interest to help them adopt technologies which will help them manage their carbon balance.

Environmental damage

The image of this first phase of change still lingers on with inferior products produced at low prices at ridiculously low wages and causing a great deal of environmental damage.

This is not the reality of the second phase with some of the most sophisticated and large scale manufacturing operations in the world. Of course wages on the shop floor labor are still low, but there is now a sophisticated, well trained and paid middle management.

The environmental impact of this first wave of industrialization has been disastrous, with air and particularly water pollution being excessive. As virtually all water supplies originate from the remote Tibetan plateau the water travels great distances increasing its pollution at every kilometer, presenting the water authorities with a major problem.

The Chinese Governments have made major efforts to combat this problem with varying success, many of the rivers are still highly polluted, in some case bright green from the algae, however there is no doubt that this has dramatically motivated the Chinese Government to adopt environmental practices. See Greening of China (3).

China is a willing recipient of technology which will help them, and hence us, manage carbon emissions

Technology's role in changing China's society

China is not a homogeneous society. There is now a well established middle class with a standard of living comparable to Australia. However they have far lower emission per person than in Australia or other developed countries.

Electric scooters are the most common means of transport, the public transport system by high speed electric trains is efficient.

The new blocks of apartment under construction all seem to have solar hot water heating on their roofs.

The major source of emission must be the power to run the ubiquitous cooling units which adorn virtually every building

However there is a mass migration of unskilled workers from the rural areas to the western seaboard and inland cities such as ChenDu, Chongqing, Wuhan etc. The scale of the mass migration of people is daunting

with millions of people migrating each year, looking for an improvement in living standard by becoming part of a developed society.

Some of these have been educated in the massive Chinese educational system which is producing large numbers of graduates, many from poor back grounds. Parents go to great lengths to educate their child, but in Chinese culture the child is expected to support the ageing parents. This put great pressure on them to be successful.

Many of this vast army of young graduates have difficulty in initially finding employment commensurate with their paper qualifications but eventually they are absorbed into productive employment in the ever expanding commercial system.

They then join the ranks of the established middle class carbon emitters. This is a very different scenario to Australia in which increasing affluence is widely spread across the population.

In China millions of people cross a line from poverty to a reasonably affluent living standard. It is virtually impossible stop people crossing this line.

In Australia the population had generally accepted that they should accept a slower rate of growth of wealth in order to protect the future of their children. In China it is a totally different challenge to persuade a recent graduate surrounded by an affluent society that he should adopt the poverty of his parents so that the affluent polluting West can continue to drive their kids to school in two tonne 4WDs.

Inevitably this means that the demand for energy is virtually unstoppable. Even with the power of a centralized Government this ever increasing demand for energy will continue to grow. The Yangtze River is a continuous stream of coal barges.

Fred Krupp, of The Environmental Defense Fund recent book – Earth: The Sequel (4) is probably one of the better and well balanced books on the alternative sources of energy. This reviews the range of non or minimally polluting alternative energy sources. In many ways this is a comforting book as it analyses and reveals the potential of these various technologies, however what is evident is the vast amount of further research and or capital investment before these technologies can have an impact on emissions.

I am not going to debate the ethics of advanced western countries who have caused most of the current emissions, expecting countries like China who have currently far lower emission per head to curtail their current emissions.

I am simply saying that it seems very unlikely that the Chinese Government would accept a curtailment or even reduction of its current emission levels. And even if by some political miracle they did accept restrictions there would seem virtually no possibility of the Government achieving this in practice.

In the longer term there are some steps they could take to reduce emissions; China does have large areas of desert which would be suitable for solar thermal power generation. But this must be evaluated against the amazing increase in demand for power.

When the three dams' project was started it was expected to produce 15% of the countries total energy requirements. By the time is was completed the demand for power had increased so much that it is now only expected to provided around 2% of total power.
Even if, for example solar thermal power was fully developed with the capacity for overnight thermal storage, and China decided to adopt this on the same massive

scale as the three dams project it is more than likely that energy demand would have grown faster than the extra energy from these clean energy sources.

The reality is that the emissions from China (and the other developing countries) are going to increase by large amounts over the next few decades.

This will dwarf anything we do in Australia to cut our emissions. This is a simple brutal fact of life we have to accept and develop strategies to compensate.

If we as a Nation want to protect ourselves from the further global warming from these developing countries we have to be far more proactive than simply cutting our own emissions. If we took just one indicator of global warming, for example the current water shortages in the Murray Darling Basin, we can say with certainty that this is only a foretaste of what is to come as the developing nations come on stream.

In Part 3 I will discuss technologies which provide a strategy whereby we can assist China and the other developing countries to reduce their net emissions.

Part 3 absorbing carbon in the soil

Countering the sand storms

In the late seventies and early eighties Australia suffered horrendous sand storms with millions of tones of top soil being lost, even reaching across the Tasman to New Zealand.

By this time my company, which was based on the principles of speculative, high risk - high reward research, had the capabilities of carrying out serious research. I saw this loss of top soil as a major threat to our food production capability and decided to set up a long term research program to find out how to regenerate top soil.

At this time I had not even heard of global warming or the carbon balance, my interest was simply in creating top soil at a viable rate. The literature indicated that the natural rate of generation of top soil was measured in mm per century. I felt there should be a way of speeding this process up.

My initial approach followed the classic scientific approach of taking an area of land which had been totally denuded of top soil, dividing it up into small squares, looking for any product or process which claimed to regenerate soil and looking at what happened. The results were almost a total failure, there seemed to be no simple way of regenerating top soil.

I thought that maybe a combination of inputs was required and following the lead of the Taguchi approach for multi variable analysis set up a new series of trials.

This time there was some success as some areas had excellent soil generation however the results defied any form of mathematical analysis as per classic Taguchi. Putting it bluntly we were generating soil but we had no idea what were the critical ingredients.

The test block appeared to be reasonably uniform, just a regular paddock with a slight slope, however as we took soil samples we realized that the moisture content was far from uniform. It appeared there were underground fissures which acted as sub surface flow channels when it rained.

The areas which tended to saturate had little regeneration, basically sub surface bog holes with a dry crust. The drier areas again showed little regeneration.

Even where a high organic content had been added, there was no combination of the organic material with the soil particles, they remained a physical mixture.

The areas with good regeneration had a combination of balanced soil moisture and organic input plus a few other ingredients. The organic material was no longer a separate phase, we had a genuine homogeneous soil.

Clearly micro biological action was playing an important role and I would like to divert for a moment to examine the reasons and try and explain the differences between a mixture of soil and organic material with multiple phases and what happens when genuine soil is formed with a single homogeneous phase.

Primary and secondary bonds

With some apologies I am going into the world of the strength of materials (my first job after leaving university was researching the mechanical properties of polymers).

Polymers (long chain organics) have the common characteristic of a long chain carbon back bone, with various side groups. The chemical nature of these side groups gives different type of polymer their specific characteristics.

The backbone of each long chain molecules is inherently strong, there is common electron sharing which give each of these long molecules significant strength; they are not easily broken. These chemical bonds are referred to as primary bonds.

However if there were no connection between these molecules we would have the equivalent of noodles in a soup, the material could be easily torn apart without breaking any individual noodles; they would simply slide one over the other. This is of course what happens when plastics creep; it is not movement within each molecule but one molecule sliding over another.

This is where the secondary bonds resulting from the attraction between molecules, (often called Van de Waal forces) come in. Parts of each long chain molecule may be in close contact with parts of other molecules so each molecule is loosely bonded to other molecules. This creates a three dimensional structure with mechanical strength.

Another way of looking at these within and between molecules (intra and inter molecular forces) is to look at a piece of metal which has broken into two bits.

It does not matter how carefully we place the two broken bit together it still remains broken. This is because at the molecular level there is hardly any contact between the two pieces.

On the other hand if we touch two pieces of metal together, in which the surfaces have been honed so they are flat near flat and smooth, we would find they are amazingly difficult to separate. There is no mechanical connection between the two pieces of metal; it is simply that there are enough molecules of one piece of metal in intimate contact with molecules in the other piece of metal (e.g. contact at the molecular level). These secondary forces generate a powerful bond.

These secondary forces may seem to be some academic abstraction, but literally the world would fall apart without them. An incredibly important role is the attraction between water molecules which gives what is nominally a fluid some tensile strength. This is the force which enables plants to literally pull up water to great heights. (The much more publicized surface tension and osmotic forces can only raise the water a few centimeters).

The micro biological action in the soil is working on the surface of the soil particles allowing these secondary forces to bond the organic content into the soil so it is firmly bonded in place.

At that time I had very little knowledge of soil microbiology and took the empirical approach of finding out the conditions which would support microbiological action. Maintaining the correct moisture content was clearly one of the vital components.

Changes in farming practices

The loss of top soil had a major impact on farming practices with the widespread adoption of no till farming, tree planting, and other methods to preserve the top soil. It is worth noting how dramatically effective these changes have been and since that wave of dust storms in the early eighties we have had hardly any significant dust storms.

At that time I had not even heard of global warming and recognized this as the threat that it is, so I switched my interest to how to manage water. The experiments had clearly indicated the importance of controlling the moisture levels in the soil so I now focused on how this should be best achieved. This was largely motivated by the obvious degradation in the Murray Darling Basin.

I saw that water was going to become one of the most critical issues to face the world and wanted to devote more of my time to looking for technological solution to these environmental problems. I sold my company Moldflow and set up a team of some twelve specialists with a range of expertise to apply the principles of speculative research to study how to make more effective use of water.

Initially we focused on the high technology approach focusing on two major projects which appeared to have the most potential - sub surface irrigation and intelligent control of irrigation based on soil moisture sensing.

The research on subsurface irrigation was disappointing as it seemed that the many practical difficulties limited its practical use. However the development of an intelligent process control system for irrigation control was a major technical success. However it was a sophisticated technology which was beyond the skills of the majority of farmers.

Attempts to interest the various Governments in this technology, with a view to setting up a major educational program for farmers were totally unsuccessful. However it did result in a major shift in the research direction which in the longer term may have had major benefits.

Sustenance food and environmental collapse

I decided to focus my research onto the problems of providing sustenance food in developing countries and working with World Vision, spent time in Africa, primarily in Ethiopia.

This had both technical and psychological impact. Again at that time I was still unaware of global warming, and with hind sight there is certainly a possibility that global warming could be part of the cause of the creeping desertification in Sub Saharan Africa.

Law of the commons

However there is no doubt that man made environmental degradation has resulted in immense suffering. The wide spread deforestation has caused massive soil erosion and consequent food shortages. It is impossible not to have some empathy with the individuals who are responsible for the wide spread deforestation.

The simple reality is that they have a pressing need for firewood, particularly to boil the highly polluted drinking water. The real problem is the lack of an effective Government to control the destruction of the forests and provide effective alternatives to drinking contaminated water, even though that technology already exists.

Seeing first hand the misery caused has made me very sensitive to the dangers of global warming (and perhaps less tolerant of procrastination).

This is the well known law of the commons which explains how societies can end up by totally destroying a shared asset. We see this at work in the lobbying of the various pressure groups that seem determined to fight for their short term benefits even if it leads to widespread destruction later.

I just hope that global warming does not end up as yet another example of the law of the commons at work.

The development of the wicking beds

However my desire has always been to focus on technology which may provide effective solutions so I will return to the theme.

Analyzing the problem showed that it was not a simple question of lack of rainfall. There are of course wide spread deserts in Ethiopia, but hardly anyone lives there, and those that do are nomadic and have developed systems of managing the lack of water.

The real problem is in the higher rainfall areas which under normal conditions have a reasonable rainfall and can support a significant population. The climate is not that different to the climate in our Murray Darling Basin with a high degree of variability. Unlike Australia there is no infra structure to enable people to cope with drought so famine is a regular occurrence.

Ethiopians regularly suffer the hardships that we are now experiencing in the Murray Darling Basin now our extensive infra structure is no longer capable of providing an effective buffer.

Further analyses lead to two conclusions. First even in drought there is still some rainfall but it falls as relatively small rainfalls. Just as in Australia the soil is so dry that these small rains are not effective. They simply dry up before doing any useful work. Secondly there is a simple problem of the timing of rainfall. The rainfall may be perfectly adequate on average but a short break in the rainfall at the critical time of when the seed heads should be filling results in widespread famine later.

Clearly I needed a solution which would first make use of the small rains which are normally ineffective and secondly which could store water for these critical times in the plants growing cycle.

The constraint was that it must be very cheap; we are dealing with a country where the average income is less that $2 per day.

The solution I developed was the wicking bed. In its simplest form this is made by simply digging a trench, lining with a polythene film to form an underground water reservoir and refilling with soil. This can be extended to fill the base of the pond with waste organic material to add nutrients.

A further extension is to extend the polythene sheet to form a water catchment. This amplifies any rainfall that does occur. Perhaps of greater importance is that it will also harvest the small rains which still occur in droughts and are normally wasted as they do not penetrate much below the surface.

Experiments with these wicking beds showed that the productivity was far higher than expected. This is a natural effect of the way water wicks up from the underground reservoir giving a good water to air balance. This ensures the soil is moist without being saturated so giving the ideal conditions for both plant growth and for the micro biological action which incorporates the waste organics into a homogeneous (or chelated) soil.

Carbon capture

I soon realized that these wicking beds, developed as a means of providing sustenance food, also provided a way of capturing carbon. Much of the soils in countries like Ethiopia are seriously degraded with little nutrient content. However by harvesting weeds, which have the capacity to extract nutrient from very poor soils, and placing these in the bottom of the wicking bed we could simultaneously increase the nutrient level and the water holding capacity.

It was then time to start looking at the soil micro biology a bit more seriously. In the early experiments, conducted many years ago the crude approach was to get the conditions right for micro biological activity and hope that some effective micro organism would essentially just turn up and multiply.

It is now better understood that there is a complex chain of microbiological action starting with the microbes, then various fungi and ending up with the larger creatures particularly the worms.

Some micro organisms are more effective than others in capturing carbon. Bacteria in highly aerobic conditions will release significant quantities of carbon back to the atmosphere while fungi in more moist, less aerobic conditions, appear to be more effective at capturing carbon.

Worms play an important role as they will distribute carbon throughout the soil and as the soil passes through their guts will help bond the organic material to the soil particles.

There are many types of worms with different characteristics; many are simply surface feeders which digest organic material which has first been decomposed. There are other types worms that will bury deep in the ground, and will typically feed on worm cast from the surface feeders and bring this deep into the soil. The cast from these larger worms have a strong highly porous structure rather like Swiss cheese which is particularly effective for holding water and nutrients.

These larger worms are particularly important from the point of view of carbon capture as they move the carbon deep into the earth.

Reason for skepticism

I have already pointed out that organic material lying on the surface or simply mixed into the soil without being bonded to the soil particles is vulnerable to being depolymerised or unzipped and will reverts back to carbon dioxide.

It is natural that there should be widespread skepticism about carbon capture in the soil if the organic material is a simple mixture near or on the surface, as is commonly the case.

It is a totally different story if we manage the conditions correctly so micro organisms can decompose the organic material to become food for worms which will combine the soil and organic material into a stable homogeneous composite which is buried deep in the ground.

Wicking beds and Global warming

With the greater understanding of the impact of global warming the importance of the wicking bed technology was realized.

As I argued in Part 1 the real issue for the future is carbon emission from the developing countries as they adopt modern technology. Countries like China may be very sensitive to the effects of global warming but in reality there is little they can do to actually cut their emission, the best they can do is to reduce the rate of increase of emissions.

We therefore have to look for alternative solutions. Plants absorb over thirty times all the man made emissions from their machines. The current problem is that most of that carbon is released back to the atmosphere. The effect of oxygen and UV light is extremely effective in breaking down the organic structure and releasing carbon dioxide.

The wicking bed provides a way of capturing this carbon and incorporating it into the soil. The most effective way to achieve this is to incorporate it into growing practices. We have already seen how effective changing farming practices can be in avoiding dust storms.

Encapsulating carbon back into the soil may well be our only hope in avoiding the threatening disaster of global warming. It is true that many countries, particularly Australia, have potential sources of alternative energy. Other regions of the world particularly the countries with a high density of population such as China do not have such options.

The major problem that I see is that the absorption of carbon into the soil has not been accepted as part of the Kyoto protocol. This makes it difficult for countries like Australia and China to adopt carbon capture in the soil.

Global warming and the law of the commons

Why is the international protocol so important? I have already talked about the starvation in Ethiopia from destruction of the environment. This does not happen from some evil intent; it is the result of some poor peasant lady trying to protect her family in the absence of effective control resulting in a free for all skirmish; - I may as well cut down the trees because if I don't then some one else will.

The law of the commons applies equally dramatically with global warming. There are pressure groups arguing 'why should I cut my emissions if China is not part of the agreement'.

The results of letting the law of the commons to prevail in climate change is almost unthinkable.

The scientific community with expertise in this area should make sure that our politicians and negotiators at the international conventions on global warming are properly informed. There must be recognition at the negotiating table that carbon capture in the soil provides a practical path for China and the other developing countries to become part of the international protocol.

This is the only route to stopping the law of the commons causing the predicted dire results.

This is the key point of this submission. I am not a foreteller of gloom; I am saying that here is a clear cut method whereby we can protect the global community from these horrific outcomes.

Message for the Australian Government

I have made it clear that people like me and Xuilan Tang are anxious to go to China to transfer the technology. I know of many other people who feel equally strongly and are taking this message to other corners of the world because they believe that this is an important action that needs to be done.

But all that sacrifice and dedication is a waste without widespread adoption.

We could try and promote the technology by arguing that there are immediate benefits for the local community; - it increases food production by improved water and nutrient use in the soil and there may be longer term cost benefits in enabling land to remain in production when there is a shortage of water. This approach has certainly led to little pockets of adoption in poor countries and among dedicated groups of environmentally sensitive people in the richer countries. But this scattered adoption is on too small a scale to have any impact on global warming.

Wicking beds marginally increase the labor for food production. These costs when converted to Australian dollars are totally trivial, certainly when compared with the cost of global warming. But we are not going to see wide spread adoption without these growers being paid for the carbon they absorb.

They need a mechanism for receiving payment. This is why the trading scheme should include carbon capture into the soil. This should be done now. Carbon absorption is a technology which has been under development for over thirty years and can be applied immediately.

It is difficult to express the importance of incorporating carbon capture in the soil into the global carbon trading scheme. We have the technology; we now need the political mechanism to achieve this.

In the covering letter I raised the idea of a historic memo from the Prime Minister to China saying Australia wanted to work with China to introduce this technology into China and for both countries to work together to have this technology accepted into the next post Kyoto agreement. Let us hope this is the outcome of this submission.

Good reading

1) Gabriel Walker- An Ocean of Air - Harcourt ISBN 978-0-15-101124-7

(2) Supercontinent Ten billion years in the life our planet Ted Nield
Harvard University Press
ISBN -13: 978-0-067-02659-9

(3) The greening of China by Geoffrey Murray and Ian G. Cook.
Imprint: Beijing : China Intercontinental Press, 2004.
ISBN: 7508505867

(4) Earth:The Sequel
The race to reinvent energy and stop global warming
Fred Krupp and Miriam Horn
W. W. Norton
ISBN 978-0-0-393-06690-6

Further reading

The unacceptable realities of global warming
Extract of talk on global warming given at the IIA conference
2008

Wicking beds and Global warming - Colin Austin Paper presented at the IAA conference Melbourne 2008

www.waterright.com.au

www.easygrowvegetables.com.au