Submission synopsis

Colin Austin 10 November 2013

Contents

Summary

Kyoto is twenty one years old, it has failed – atmospheric carbon is growing faster than ever. There have been plenty of schemes - carbon tax, carbon trading, Dutch auctions etc. but what matters are physical changes that either stop putting carbon into the air or take it out.

Ultimately we must stop putting carbon into the air but this requires new technology and could be expensive. We already know how to take carbon out of the air. Vegetation already takes many times more carbon out of the air than human emissions; the key is to get it into the soil so it stays there. This costs little and increases the amount of water and nutrient the soil can hold which increases food security and health and reduces pollution of our water resources. Soil can store far more carbon than the air but required changes to farming practices.

This submission looks at why Kyoto has failed the mechanics of storing carbon in the soil and overviews how Governments can provide incentives and assistance for farmer to change their practices.

The essence is setting up an eco-organisation which

a) Documents and supervises systems of retaining carbon in the soil for the various types of farming and regions
b) Develops software to predict the amount of carbon retained
c) Makes payment to the farmers
d) Provides accreditation of farm products
e) Provides accreditation of farm products

Preface

In this submission I propose a plan for how Australia could make a real impact on global climate change.

There are people, those who have experience floods or bush fires who understand that while climate change does not cause extreme weather it make them worse. They look forward to actions that are actually going to help.

I start by asking three questions.

1) How is it that despite all the activity on climate change over the previous decades carbon dioxide levels are not just rising but rising at a faster rate than ever before?
2) What do we physically have to do, free from all the limitations of politics and legalities to have a real impact on climate change.
3) What can we do in Australia to make these physical changes considering the realities of the world, particularly economics?

This submission focuses on the key issues and makes no pretence to cover all the details. I have written three books

Resolving Climate Change Vol 1 How Innovation can help solve climate change

Resolving Climate Change Vol 2 How the Eco-Corporation will emerge to fight climate change and

Resolving Climate Change 3 How Science can fail us which contain much more details.

They are available from Kindle Store or on my Web, www.waterrright.com.au along with much other information about soil carbon and climate change or directly from me colinaustin@bigpond.com.

Question 1

Why are we are not winning the climate challenge?

Thirty years ago there were some 2 billion people, largely in America and Europe living an industrial life and making a contribution to greenhouse gases, and some 3 billion people in developing countries.

Probably the most dramatic feature of our age it the spread of technology and industrialisation to the developing world. Today the number of people living an industrial life style has risen from 2 billion to 5 billion people. In the next thirty years we can expect that the number of people living an industrial life style will rise to 8 billion. That is the astonishing figure of a fourfold increase in a generation.

The number of people living an affluent life style will increase from 2 to 8 billion in a sixty years period.

This spread of industrialisation is unstoppable; people in developing countries are simply not going to forego the benefits of modern society. To put this in perspective the targeted 5% reduction in Australia's emissions will be offset by just a few days increase in emission from the developing countries.

The Kyoto protocol was supposed to lead to a reduction in emissions from developed countries. I am told that only 15% of emissions are from countries that have signed the Kyoto protocol, meaning it is not very relevant.

Even with the Kyoto countries the effect has been limited by political and legal constraints.

The Kyoto protocol is a bit like having a target of going to the moon but climbing a step ladder and claiming that progress has been made - technically true - but of no practical benefit.

Political restraints

The political difficulties arise from the incredibly poor presentation of the scientific facts. Classic science focused on understanding mechanisms, these mechanisms can be understood and accepted by the public. The power of the information technology has turned the scientific focus towards the mass manipulation of data. The public tend to look on this statistical approach with scepticism.

The mechanisms of climate change have been understood for centuries and can be simply confirmed using satellites data measuring the radiation being received by and being emitted from the earth.

The energy being received by the earth from the sun is steadily increasing.

The publication of this simple data would show beyond discussion that the net amount of energy being received by the earth is increasing. This energy must be balanced by the combination of increases in temperature, increases in latent heat (by evaporating water) and chemical energy (increased bio-mass). This is in accord with the indisputable laws of thermodynamics.

This is beyond debate, what is debatable is how climate change will affect humanity and more specifically how people will react.

Climate change is not a threat to human existence, the human race will survive.

Some people will actually benefit. It is probable that people living nearer the Polar Regions would welcome a warmer climate. A geriatric in Finland getting up to relieve himself at night may appreciate a warmer night time temperature. Food production zones are also likely to move pole wards into zones which already have the highest human population density.

People living In Australia where temperatures can range from near freezing to over 40 in a day are not impressed by a 2°C temperature rise.

Climate change will adversely affect a minority of people specifically those living in areas which are in danger from rises in sea level and those living in areas prone to extreme weather. There is no suggestion that climate causes extreme weather, it makes extreme weather even more extreme. While extreme weather results in billions of dollars of damage it is impossible to calculate how much the damage has increased by climate change although it is clearly significant.

The risks to Australia have not been well publicised or well accepted by the public.

The lack of public pressure for action on climate change has reduced the pressure on Governments to achieve effective action. Complying with the Kyoto targets by itself is often taken as an indication of success even though these may little effect on mitigating climate change.

Legal restraints

Climate change is a global issue, and the solution need inter-Governmental agreement to establish a set of protocols. The Kyoto protocols were developed to provide a strict legal and accountability structure. This focus on legalities and accountability has taken precedence over actually achieving benefits in the real world.

Consider the rigid interpretation of the Kyoto protocol with soil carbon; -

Conventional farming practices are actually adding carbon to the atmosphere but some farmers are actively taking steps to improve their soil which takes carbon out of the atmosphere.

Farmers wishing to participate in soil carbon schemes are theoretically expected to

Measure the amount of carbon they are capturing

Estimate the amount that will remain permanently in the soil **(permanence requirement)**

Estimate either

The amount of carbon they were previously emitting with poor farming practices or how much they are now capturing with improved farming methods the requirements.

Adjust the amount of carbon captured to determine what is additional **(additionally requirement)**

These are the implication of the permanence and additionally requirement in the literal Kyoto protocol.

These requirements have been incorporated by various Governments but have resulted in schemes which are just not practical on a large scale. The bulk of farmers think this is a joke and get on with their business of growing food which earns them real money.

The fact that soil carbon schemes have not been widely adopted by farmers is a major global limitation on effective resolution of climate change, as I will now explain.

Question 2

What should we be doing in the real world to mitigate climate change

Two stage plan

In the longer term we (that is global humanity) have to reduce our dependence on fossil fuels, this is not as difficult as may appear as the amount of energy falling on the earth is orders of magnitude greater than our energy consumption and is readily harnessed. The overriding problem is the lack of a technology to store bulk energy. Looking at the history of technology this is almost certainly soluble but will take time.

Soil carbon (with the appropriate technology) has the potential to store some fifty years of carbon emissions. The technology for capturing and storing soil carbon is a 'here and now' technology. We could start implementing this now with the appropriate plans.

Soil carbon should not be thought of as a permanent solution which allows us to continue to burn fossil fuels; rather it is a way of providing us with a window of opportunity to develop alternatives to fossil fuels.

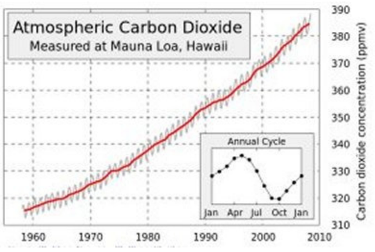
Getting to grips with scale

There already exists significant technology for capturing carbon in the soil however there is an issue of scale. We (meaning global humanity) are burning billions of tonnes of coal a year, this is a number which comes to life when viewing the coal trains heading for Gladstone or the continuous stream of coal barges on the Yangtze River. Carbon stored in the soil is in less dense form than coal so requires even greater volumes.

But to absorb carbon into the soil on this scale requires farmers throughout world to capture carbon in the soil; just having a sprinkling of farms, such as the current organic growers, capturing carbon has no significant effect. It is like having a target of going to the moon but climbing a step ladder and claiming that progress has been made – technically true but of no practical benefit.

Vegetation absorbs far more carbon than we are emitting

Plants are already absorbing far more carbon than we are emitting. This is a technical fact which does not seem to have been widely recognised.



This is easily demonstrated by the Keeling curves.

The Keeling curves are reliable data using established techniques for measuring atmospheric carbon dioxide. Most people look at the trend showing ever increasing concentrations over the years. But the changes over a year are particularly interesting.

The steep downward slope in the Northern spring shows that plants are taking carbon out of the air at multiples of the rate we are emitting.

This is even more spectacular when we think that the Southern hemisphere is out of phase with the North so the net drop is because the land area of the North larger than the South.

The just isn't any doubt about it - trees really work.

Managing the carbon vegetation cycle

So why is there a problem? Simple, the majority of carbon captured by vegetation simply goes back into the atmosphere by oxidation and decomposition. The largest emitter of carbon is not electricity generation or transport - it is simply rotting vegetation.

Planting more trees will help a little but the real key is to retain the carbon in the soil so it does not re-enter the atmosphere.

The technology to retain carbon in the soil is the heart of this submission.

Successful implementation would enable the wealthy countries to continue to enjoy the modern life style and the developing countries to expand their economies so they too can enjoy this life style without inducing catastrophic climate change.

Does that all seem too simple? Removing gigatonnes of carbon from the atmosphere is hardly a trivial technology and requires logistic as well as technical solutions

Vegetation is highly effective at removing carbon from the atmosphere. It does not appear to be generally recognized that vegetation absorbs some thirty times all manmade emissions.

The power of vegetation to remove carbon from the atmosphere may be high, but the rate of absorption is virtually balanced by an equally dramatic return of carbon to the atmosphere.

Rotting vegetation is the largest source of carbon dioxide entering the atmosphere dwarfing our current emissions.

This is an incredibly important but little published statement and it is pays to make sure the full implications are recognized.

With an understandable logic, the conventional focus has been on increasing absorption e.g. planting more trees. The more effective option is to change the system so the carbon is captured and stored in the soil.

The question 'what can we do to slow or stop the flow of carbon dioxide back to the atmosphere?' is rarely asked, yet this is the by far the largest flow of carbon into the atmosphere.

Carbon is carbon; it makes no difference where it came from. Slowing the rate of return of carbon to the atmosphere is just as effective as taking more out by, for example planting more trees.

Plants are already extracting large quantities of carbon dioxide converting this to complex organic molecules and storing energy. This is happening right now at no cost or inconvenience to us.

The laws of thermodynamics and the snag of entropy

The problem is that photosynthesis produces complex organic molecules which contain large amount of energy. This is after all what makes coal and oil so valuable. However because they contain so much energy there is a tendency for them to release their energy and breakdown into simpler but more stable molecules like carbon dioxide and methane.

This follows naturally from the laws of thermodynamics which says that a system will always tend to the most stable state (increasing entropy). Just as water always runs downhill - carbon systems always tend to the most stable state, usually carbon dioxide, with the release of energy.

The simple fact remains that we could resolve global warming by simply slowing the rate at which organic wastes breakdown and returns carbon to the atmosphere.

This simple statement receives virtually no attention in the global warming debate for reasons which are difficult to identify. It may be that the importance of this concept has not been fully appreciated or it may have been written off as an idea which is just too complex and difficult to resolve.

The dynamics of the carbon cycle

The level of atmospheric carbon is not a static problem, like water in a water tank which simply fills with water; it is a dynamic problem like water in a river.

It is dynamic, with large amounts of carbon entering and leaving the atmosphere. It is like a river which will rise if extra water is added, by say a tributary receiving local rainfall.

This is what has happened with manmade emissions; a small extra input upsets the dynamic balance thereby raising the level. Reducing the rate of return of atmospheric carbon will lower the level.

It is wrong to think about permanent levels of soil carbon, what matters are the **rates** at which carbon is being absorbed and released. If the rate at which carbon is absorbed is greater than the rate at which it is being released the net carbon in the atmosphere will drop.

The decomposition of organic waste

Vegetation contains complex organic molecules which contain high levels of energy which is easily released. The laws of thermodynamics say that there will always be a tendency for the complex molecules to break down into simpler, low energy molecules.

Factors that cause the rapid release of carbon dioxide

When vegetation is burned, almost all the carbon is converted to carbon dioxide.

The combination of oxygen and UV light is equally effective. It may be slower and less spectacular (and indeed unnoticed) but organic waste left on the surface will decompose by UV initiated molecular decomposition converting almost all the organic material to carbon dioxide.

Organic material under the ground where it is protected from UV light can still be attacked by aerobic bacteria releasing carbon dioxide.

Immersion in water leads to anaerobic decomposition, typically by bacteria or algae with the release of methane, a more potent greenhouse gas than carbon dioxide.

Factors which slow the release of carbon back into the atmosphere

Decomposition under controlled conditions can create residues which are complex but stable molecules, generally referred to as humus, which are thermodynamically stable and improve soil quality.

The most effective method of storing carbon in the soil is decomposition by fungi.

Fungi are particularly effective decomposers which, while still releasing some carbon dioxide to provide their energy source, are particularly effective at improving soil quality.

Fungi form large underground structures and the tips of their hyphae excrete enzymes which penetrate rocks and soil particles, bonding organic matter and the soil together. The result is a strong open soil structure highly beneficial for plant growth and with the organic material locked into the soil particles.

Mycorrhizal fungi are particularly beneficial. They form a synergistic relationship with the plant in which the plant provides sugars for energy while the fungi send out their hyphae which have a far larger area then the roots. They are extremely fine and able to collect nutrients and water which they trade with the roots in return for sugars.

The plants extract carbon dioxide from the atmosphere which with the aid of sunlight is converted to sugars and starches which feed the mycorrhizal fungi which in turn exude chemically stables compounds which form the basis of stable humus.

To summarize: - all methods of decomposition release energy and carbon dioxide, this is inevitable, but some methods such as burning, release virtually all the carbon while other methods, such as fungi, will only release a small amount of energy and leave a remainder of stable organic material.

This stable organic material can be embedded in the soil creating a highly productive organic rich top soil.

Macro soil organisms are also effective decomposers which again may leave stable residues.

The humble earth worm, for example has bacteria in its gut for decomposition, which again releases carbon dioxide but it also releases chemically stable glue which lines the outside of its burrows which stabilizes and aerates the soil.

Deep feeding worm will take organic material from the surface and which would otherwise readily decompose under UV light and take this material deep into the ground where it is protected.

The rates of absorption and release are the critical issue.

It is neither possible nor desirable to stop all carbon being released back to the atmosphere. That would be a total disaster as with the rate that plants absorb carbon too much would be absorbed and the world would be thrown into an ice age. The aim should be to capture a proportion of the carbon on a semi-permanent basis as chemically stable residuals after the energy has been extracted.

Atmospheric carbon dioxide is not a pollutant as often said by extremists, it is the source of virtually all our food. Equally there is no doubt that we are adding carbon dioxide to the atmosphere, we just have to develop the technologies to control the level.

It is not necessary that carbon be stored permanently in the soil, this is one of the great errors of conventional soil carbon thinking.

What really matters are the rates of absorption and release.

If the release of carbon by plants is thirty times man made emissions then it only requires the rate of release to be reduced by 3% to counter all man made emissions.

Atmospheric carbon is dynamic, with large flows into and out of the atmosphere. The carbon captured does not even have to be permanently retained; all that is required is for a floating balance to be achieved.

Farming practices and the soil carbon debate

Soil is second only to the oceans as a carbon sink. The amount of carbon in the soil far exceeds atmospheric carbon. We only have to look at the Savannah belt stretching around the world in both hemispheres to see soil many meters deep holding large amounts of carbon. This has been building up over many years.

Look at all the coal and oil we use and is causing global warming; - this has all originated from vegetation which has extracted carbon from the atmosphere and then resisted degradation so the carbon has been conserved.

Natural undisturbed land tends to accumulate carbon in the soil, while traditional farming techniques tend to release this carbon back into the atmosphere.

The essence of this proposal is to provide a practical and workable system to encourage farmers to change their farming practices to improve their soils by increasing the organic content.

Of course many farmers are already doing this. Modern farming techniques, such as no till farming, were developed to improve farming productivity, particularly by avoiding loss of water compared with conventional ploughing.

They were not developed specifically to capture carbon; - that is just a fortunate by-product. We have to look at what can be achieved by modifying farming specifically to capture carbon. In the short term this will cost the farmer more money so we have to find some equitable way to pay the farmer for capturing carbon. The improved soil is a longer term benefit for the farmer.

Carbon can also be sequestered by growing carbon crops or incorporating external sources of organic waste. This greatly increases the soils capacity to capture carbon.

When organic material is added to the soil the natural microbiology will use this as an energy source and release either carbon dioxide or methane to the atmosphere; - this is inevitable. But a certain amount of the organic material will end up as chemically stable residues which can become locked into the soil. These residues are what we need to focus on, not the component which is readily broken down and re-enters the atmosphere.

These residues can build up very large volumes. Every mm. of carbon stored over the farm area of China equates to a gigatonne of carbon stored.

It is time to rethink soil carbon afresh.

Carbon in plants does not exist as raw carbon but as complex organic molecules. The more complex they are the more easily they break down to form carbon dioxide. The soft tissues and leaves are highly unstable and are easily broken down by sunlight, bacteria and fungi as well as being eaten by many creatures, like cows and sheep, which convert them into carbon dioxide or methane.

Lignin or the hard substance in wood is relatively stable but is broken down by fungi, cut up by termites (for decomposition by captive fungi) or simply burned. Decomposition involves some release of carbon dioxide but may lead to the formation of humus.

Humus is highly stable, lasting for hundreds of years on the soil and is the key to soil carbon sequestration.

Much of the organic material from plants simply ends up as carbon dioxide without forming humus, however by carefully managing the process of decomposition, higher proportion of the carbon can be formed into the stable humus.

Bacteria and Fungi

Bacteria and fungi both decompose organic material, but they do so in very different ways. Bacteria are microscopic and (generally), they obtain their energy by decomposing organic material using oxygen and nitrogen and releasing carbon dioxide. They have relatively short lives when their bodies are attacked by further bacteria, so very little of the atmospheric carbon is retained in their bodies. They are most active at higher temperatures with ready access to air.

Fungi are fundamentally different, like bacteria they obtain their energy by decomposing organic material, they need less oxygen and nitrogen but they are very long lived with much of the carbon being retained in their structure. They can form very large structures, the largest living organism is a fungi spreading over several hectares.

The mycorrhizal fungi form synergistic relationship with plants; the plants provide them with energy in the form of sugars while the hyphae of the fungi extend over a much larger area and are finer than roots and more efficient at extracting nutrients and water from the soil. They increase plant growth significantly.

The key to absorbing carbon from the atmosphere into the soil is to manage the conditions to favour fungal rather than bacterial activity and to minimise oxidation.

Bacteria are small and tough so will not be easily killed by working the soil. Fungi are the opposite; they form very large structures which are easily broken by any form of working the soil.

While bacteria will thrive under a wide range of conditions fungi are much more sensitive. The key is to generate conditions which benefits fungi, the key conditions are moisture, PH and an abundance of calcium.

No till farming improves the retention of fungi but the most effective way is by having alleys or islands of undisturbed soil which becomes a safe haven for fungi. The fungi can then readily inoculate nearby crop production land.

This mean the farmer must sacrifice some of his land for these soil biology refuges. This strategy of mixing refuge areas among production area is far more effective than setting aside large areas for say tree production while leaving the production areas as large areas of monoculture.

Water management and carbon farming

Water is crucial in the fungi - bacteria balance. There are bacteria which will thrive in dry conditions and others in very wet conditions. Fungi are much fussier only thriving under a limited range of moisture levels.

One technique to ensure the stable moisture levels for fungi to thrive is based on the wicking bed principles. A decomposition chambers is used where organic waste can decompose under controlled conditions favouring fungal decomposition. These are very simple. A trench is formed and lined with a waterproof liner such as a polythene film. Certain leaves, such as eucalyptus leaves, are effective at sealing the soil and provide an effective alternative to plastics film.

Organic material is buried in the soil into these lined channels (which also act as a means of irrigation), which are periodically filled with water. These damp conditions favour fungi decomposition over bacteria.

Inoculants in the form of worm eggs and mycorrhizal fungi are added so bacterial decomposition is largely replaced by fungal decomposition.

The mycorrhizal fungi will attack the organic material to extract nutrients and water which they supply to the crops, this is a very productive system which enables the farmer to grow more food from smaller areas.

Second we must have a large supply of organic material. This has to be on the scale of billions of tones. It is the scale that presents the challenge.

Sources of organic waste

The first and simplest source is agricultural waste which is already available on farm.

The amount of agricultural waste is insufficient to balance all the carbon we are likely to be emitting in the future.

But we can increase the amount of organic material in a number of ways.

The wicking growing system is highly productive so the farmer can devote some of his farm to grow carbon crops. These may be fast growing plants which can be pruned or with the ability to copse. These can be repeatedly chopped or pruned to provide a regular source of organic material. They may be productive trees in their own right, for example fruit or timber trees. Again these can be supplied with water and nutrients from the lined channels so they are highly productive.

Sewage, forests and cities as a source of carbon

As these plants, superficially grown to capture carbon, are non-food plants, sewage can be safely used to provide both water and nutrients. In the lined channels there is no danger of sewage entering the water table.

The farmer can also select deep rooted plants which mine nutrient from deep in the earth.

Forests are an additional source of organic waste. Forest waste, trimmings and undergrowth can be granulated to form the organic material. This minimizes the risk of forest fires and avoids the need for controlled burnings to remove excess fuel.

Our cities provide an additional source of organic material. The design of cities is undergoing a major rethink, with a tendency to high rise buildings and parks. The parks can be designed for a combination of recreation and carbon capture.

Even the traditional suburban layout can generate organic material by setting up green waste recycling schemes.

Cities produce millions of tonnes or organic waste, often this is disposed of in land fill which is particularly harmful as it generates methane. Again this can be separated and recycled on farm to improve soil and retain carbon. Urban waste is a major source of carbon.

But we should not be totally focused on climate change; we should look at the wider problem of ensuring a sustainable system which will not damage the environment when we have a population of some 9 billion affluent consumers to feed.

This increased population will create major problems in ensuring sufficient nutrients (and water). Fertilizers, particularly nitrogen are highly energy intensive while phosphorous is becoming in short supply.

There is a general reluctance to use human sewage directly on food crops. This can be used on farm to provide nutrients and water for fast growing plants, particularly varieties that copse.

This would mean that some farm area would have to be sacrificed for carbon capture but this loss would be compensated by the increased productivity in the decomposition beds. The safety hazards of using sewage are avoided as there is no connection between the sewage and food crops.

We need to be looking at our total land area to seek additional sources of organic waste.

The key is discovering that process and that is where limits of the scientific process become apparent.

System for soil carbon

Let me summarise the current state of the art for capturing and storing carbon in the soil. The essence is to manage the soil biology. These are the key features.

Continuous plant cover - soil biology relies on plants for energy. There must be a continuous supply of energy from plants or the critical fungi will die. This can be achieved by intercropping e.g. by planting the next crops between the existing rows before harvesting the current crop or using permanent plants in alleys or islands. Using the land for a period under permanent pasture is another method.

Mycorrhizal fungi - plants take carbon directly from atmosphere, convert to sugars and carbohydrates which are taken up by the fungi which exude complex polymers into the soil which forms humus. Unfortunately mycorrhizal fungi are slow growing and delicate and require consistently humid soil. They are easily killed although the spores are very tough - this is their survival mechanism.

Deep burrowing worms - worms fulfil a number of functions in soil regeneration. Plants drop a large amount of organic material on the surface however if left on the surface much of this will simply oxidize without benefiting the soil structure. To be useful the organic material must be well below the surface. The right breed of worms, the deep burrowing varieties, will drag this surface organics deep into the soil.

Worms also seem to play an important role in helping mycorrhizal fungi to spread. It is not known whether this is caused by spreading the spores, aerating the soil or providing nutrients for the soil.

Bacteria - bacteria provide food for the worms that cannot directly digest plant material. They may eventually release nutrients to the soil but initially absorb nitrogen and do not contribute greatly to soil structure. Bacteria are however extremely tough and can survive over a wide range of conditions, wet or dry, and breed very rapidly.

Moisture - continuous moisture is critical in soil regeneration. Fungi and bacteria are in continuous competition for food; fungi are the most beneficial for soil regeneration but are easily damaged and need a consistently moist environment.

Fungi, which are critical for soil regeneration, are slow growing and only flourish over a narrow range of moisture.

Bacteria by contrast breed very rapidly and are much more robust and will flourish under a very wide range of moisture. Both fungi and bacteria are in competition for the same food supply. A key element in soil regeneration is to create the conditions where the fungi can out compete the bacteria. This means maintaining a steady moisture level over time.

The wicking bed technology is a system in which a reservoir of water maintains the soil moist by wicking action so the soil is kept moist, not saturated.

It is often used in conjunction with rows of ‘soil trees’ typically deep rooted legumes which add nitrogen and mine phosphorous. These also provide a home for mycorrhizal fungi.

Hugel Culture

Hugel culture is an old system from Western Europe which involves burying logs, forest waste and compost under the soil. The logs decompose into a spongy material which holds large amounts of water, which is its main use but also embeds carbon into the soil.

The next section will look at how to achieve wide spread adoption of these techniques and will promote the development of operating manuals for the farmers. This summary is just a summary of the principles. The operating manuals will need to be far more comprehensive looking at how these basic principles can be applied to different types of farming in different regions.

Question 3

What can Australia realistically do

Australian skills and expertise

We are facing two problems, in the longer term developing a way of storing energy to allow the more effective use of non-fossil energies and in the short term developing a system for capturing and storing carbon in the soil to provide us with that window of opportunity.

I see no particular expertise unique to Australia for tackling the energy storage problem but there is no doubt that Australia is a world leader in soil carbon. We have that combination of practical farmers learning how to farm under some of the most challenging conditions on the earth together with the scientific capability.

This is not intended to be a detailed plan - that requires much more work and preparation and detailed discussion with relevant organisations. The aim is to establish the basic principles.

Organisational structures

I have already described the basic principles of soil carbon capture, now I want to address that critical question of what organisation structures are needed to make it happen.

There is a critical decision which needs to be taken on the strategy. There are two distinct and opposing options.

The first option is to attempt to comply with the strict Kyoto protocols the second it to develop a system which can be first demonstrated to work effectively in Australia and can then be used as a template for the rest of the world.

The fact are clear, the Kyoto protocol was first developed twenty one years ago. In that period emissions have not reduced rather they are increasing at an ever faster rate. The Kyoto protocols only represent some 15% of global emissions and leave out the critical countries, particularly the developing countries, whose cooperation is essential for success in combating climate change.

China is the largest emitter and acts as a flagship for the rest of the developing world but still only represents a small proportion of the developing world. The support of nations in the rest of Asia, South America and Africa are essential.

The concepts underlying the Kyoto approach to soil carbon are based on false premises, have resulted in schemes which are essentially so complicated as to be unworkable and have been rejected by the majority of farmers' world-wide.

Historically the protocol has been ineffective and a waste of both Government and farmers time and money.

At best following the Kyoto protocols may result in planting a few trees on otherwise barren land which could be described by the step ladder method of going to the moon, making progress but in reality totally ineffective.

Any free thinking person, not constrained by political or organisational ties, which looks at the problem honestly would have to say it is time for a rethink and the development of a system that actually works.

First let us define objectives.

The aim is to develop a system where farmers change their practices so the rate at which carbon is being captured into the soil is in excess of our global emission to give us time to develop economic alternatives to fossil fuels.

Lesson learned from experience

I became interested in soil regeneration over forty years ago when Australia suffered horrendous dust storms. As my business was the development of technology I decided to undertake research on soil regeneration.

I started off with the classic reductionist approach to science with carefully laid out trial plots varying a single variable at a time. In a way this was a technical disaster as it showed there was no single magic bullet to regenerating soil. On the other hand it was a most powerful learning experience as it showed that soil regeneration requires building up a working eco system in the soil. This eco system need a combination of plants, bacteria, fungi, worms and the other components of the complex eco system of the soil.

We are looking at a multi variable problem where many factors have to be brought together and work in unison.

This lesson is still being learned, recently in my area cane farmers decided to experiment with mycorrhizal fungi, it was not a success as the fungi failed to spread. Selected breeds of worms are needed to transport the spores throughout the soil; they in turn need bacteria and plant material to provide energy and nutrients.

My current interest is in developing what is in essence miniature eco system which can be used to inoculate soil.

Complex information trail

Reductionist science is not naturally suited to multi variable problems like the complex eco systems of the soil. This is aggravated by the fact that is takes several years to develop a working eco system. But there are many other sources of information and over the years I have collects thousands of reference and sources.

Some from working farmers are soundly based on practical experience over the years, there is much information from permaculture and gardeners and there are also various cult sects with magic potions that are more than likely nothing more than quackery.

Sorting out all this information, from reductionist science, practical experience of those working with the soil to the often daft proclamations of the pseudo religious sects is not easy, and is a horrendous task for a farmer who has to earn a living by growing crop to sell.

This is why I strongly argue that system which just throws money at the problem is simply a waste - their needs to be a support structure to provide information and expertise to farmers to help them improve their soils and capture carbon.

As farmers already have a vested interest in improving their soil this support structure will have far more benefit than simply financial incentives.

Capturing carbon in the soil required creating a soil eco-system, this is a complex technology. Money alone is not enough the technology has to be made accessible by a support structure.

Farming is a tough business

A business person looking at this challenge of changing behaviour would say I first have to understand the business of farming and what will motivates farmers to change. It is a waste of time and money to have a scheme which is not widely accepted by farmers. Getting farmer acceptance is way ahead in importance of legal and accounting issues.

The business of farming is producing food and fibres (and sometimes other products like oils). Farmers are probably the most sensitive group to the hazards of climate change, particularly increases in severity of the natural flood and drought cycle but they are not there to solve the climate problems of the world. They may be receptive and willing participants in resolving climate change but it is not there job to solve it themselves on behalf of the rest of the community.

The community needs to ensure that they are adequately rewarded for the service they can provide and are not too hindered by unnecessary complications or bureaucracy. Farmers have to face wider range of hazards than most other businesses, not just the normal ones of weather, pest deceases etc. but the crucial issue is in selling their produce into markets which are often dominated by large, often multinational organisations who have far greater market power than the most farmers.

Money talks

It is probably fair to say that getting a fair price for their produce is one, if not the dominating, issue for a farmer.

It also needs to be recognised that in other soil carbon schemes the potential revenue that could be generated is trivial in relation to the value of the crops. From my observations farmers are not going to adopt a soil carbon scheme for almost trivial immediate financial gain, rather they would have taken a decision that it is their interest to improve their soil, which can be expensive, and soil carbon schemes are a way of helping to offset the costs of soil improvement.

This is particularly significant as increasing the carbon content of the soil, (particularly if this lead to a larger fungal population coupled with minerals), leads to food with a much higher nutritional value.

This is of great social importance; we are faced with food in which the nutritional values, particularly of trace elements and minerals have been declining. This has led to major problems of obesity and its associated deceases of heart attacks, diabetes etc. which cost the Government and community large amounts of money.

It is essential in developing a strategy for capturing carbon in the soil that the focus is not just on climate change but includes such factors as the national health, the improvement in water usage and storage and the reduction in the leaching of chemicals and nutrients into our water systems.

Soil is a national asset which needs safeguarding.

In thinking about the plan I am convinced it has to be holistic taking into account all of these factors.

Soil improvement by capturing carbon in the soil is a complex technology needing a sound knowledge of soil biology. Some farmers are extremely proficient in this area but this is not universal. Farmers are unlikely to be interested in a crude tendering scheme which I imagine would be a failure with minimal uptake. They would be looking for technical and business advice on how to make the transition.

The eco-organisation

This leads me to the conclusion of the need for an intermediately organisation. This I promoted in Book 2 of my trilogy on climate change, 'How the eco organisation will emerge to fight climate change'. This was a look into the future of climate change action where I was thinking along the lines of an eco-centred commercial organisation.

The success of such an eco-organisation would of course require that the Government would already have set up the conditions in which such an eco-organisation could prosper. This has not happened as yet, but I see no reason why at first this intermediate organisation should not be a Government entity but later this role could be adopted by an offshoot of an industry organisation or regional consulting organisations.

Soil carbon software

While technical support would be an important part of this eco-organisation role the business service is likely to be the most important. One of the major restrictions of other soil carbon schemes is the requirement that the farmer is responsible for physically measuring the increase in carbon content of the soil. This can be an expensive operation which is likely to be more than the cost of any revenue derived from increasing the carbon content of the soil. This would kill of any such scheme upfront.

While the immediate issue is developing such a scheme for Australia, the long term aim is to have a scheme which could be used in developing countries. I cast my mind back the time when I was studying agriculture in China where there are literally millions of small, almost identical farms. The concept of millions of Chinese farmers undertaking their own individual tests illustrates just how ridiculous such a scheme is.

I see the key roles of this eco-organisation are to develop manuals or operating procedures for the farmer to follow. It would then develop software packages, probably web or mobile phone based, which would enable an instantaneous calculation of the amount of carbon capture in a given time period.

At first sight it may seem ambitious to develop such a piece of software, however a drive from say Melbourne to Cairns may show different agricultural zones but in reality involves driving for hours on end through similar regions. Breaking down the different regions into zones, which have similar characteristics seem perfectly viable. I say this having founded and built up one of Australia leading exporters of technical software based on complex computer simulations.

The software would be tuned against selected actual field data such that it is essentially an interpolation system, this would be paid for by the eco-organisation with expected Government support.

A software package to that predicts changes in soil carbon would have world-wide benefits in fighting climate change by soil carbon.

Who bears the risk

There is a debate as to whether the farmers should be paid a standard fee for following a set carbon capture procedure with the eco-organisation spreading the farm variability or whether the farmer should be paid based on an estimate of the carbon captured.

A standard fee for following a set procedure is certainly the simplest and most practical although it may offend those more interested in following a legalistic and accounting approach rather than getting the carbon into the soil.

Mineralisation of the soil would form part of the operating manual. This would be accompanied by certification. This would immediately give the famers benefits as now there produce carries a certification on mineralisation which would be highly attractive to consumers and increase and secure the revenue for the farmer. This may have far more impact on encouraging farmers to participate in the program and hence capture more carbon.

The essence

The essence is setting up an eco-organisation which

a) Documents and supervises systems of retaining carbon in the soil for the various types of farming and regions

b) Develops software to predict the amount of carbon retained
c) Makes payment to the farmers
d) Provides accreditation of farm products

Conclusion

Let's start by saying what we should not do.

The Kyoto protocol, which was influenced more by political and legal requirements rather than sound technology, has led to soil carbon schemes which are so complex and expensive for the farmer to implement that they have virtually zero chance of having any significant impact on climate change. For example the cost and complexity of individual farmers measuring increases in soil carbon can be greater than any financial rewards to the farmer. This may be legally correct according to the Kyoto protocol but effectively prevents any wide spread adoption.

In this submission I have focused on simple and practical schemes which could achieve wide spread adoption (even if this does not comply with the Kyoto protocol). This scheme would obviously be trialled first in Australia but success here would lead to wide spread adoption throughout the world. This export of technology would have major financial benefits for Australia offsetting any decline in our coal exports.

Soil carbon is much wider than climate change, it improves the health benefit of food which helps counter the epidemics of obesity, heart decease and diabetes and it increases the capacity of the soil to hold nutrients and water which increases food security, particularly in a climate with more extreme weather and reduces pollution of water ways.

The greatest contribution Australia could make to climate change is developing a simple and practical system where farmers around the world, particularly the developing countries, have the technology and incentives to capture carbon in their soils. This also has major health and environmental benefits.