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The Secretary,
Standing Committee on Primary Industries and Resources,
House of Representatives

Inquiry into the role of government in assisting Australian farmers to adapt to the impacts of climate change

Sue Edwards M.Env.Sc
Biological Farming as an Adaptation to and Solution for the Effects of Climate Change on Agriculture

Summary of Main Points:

1. Biological farming can greatly help the farming sector to adapt to the effects of climate change
2. Biological farming can also lead to adaptation by becoming part of the solution, reducing greenhouse gas emissions, and increasing carbon sequestration
3. A whole systems approach is needed
4. The main methods are through improved water storage, improved soil structure, building and nourishing soil life and microorganisms, managing nutrients and carbon, and reducing evaporation
5. Increased soil carbon and humus can become a massive sink for carbon
6. Most important of all methods is the building of soil humus
7. Government can support this necessary transition in agriculture through various strategies including partnerships with farmers for demonstration, education and extension sites in all regions and states, and through the re-imbursement of farmers for steady improvements in soil carbon and humus content.
8. Carbon trading schemes are not adequate and only allow farmers to benefit from their good efforts at carbon sequestration by selling their carbon credits to polluters, leading to reduced net benefits.
9. A carbon tax on polluters would be far preferable and would allow the reimbursement of farmers who already have trouble surviving financially

Introduction and Background Issues: Benefits of Biological farming

Biological Farming, Nutrition Farming, and Bio-energetic and organic methods of farming are all approaches to managing soil, crops and life energy on the farm. They can make the farming sector less vulnerable to the effects of climate change, through helping it adapt to and cope better with these effects.

In addition to this, and even more importantly, these approaches can also make a huge contribution in their own right to the reduction of greenhouse gases in the atmosphere. Perhaps the greatest adaptation or 'evolutionary advantage' is to become part of the solution rather than part of the problem. It is people, in government, academia, the general public and the farming sector itself who have the ability to use their intelligence to respond in adaptive ways by proactively reducing or ameliorating the problem rather than simply reacting to it.

I would like to address both aspects of 'adaptation' in the suggestions that I outline here and ask that the committee also encompass these broader but vital parameters of enquiry. There is of course some overlap in the two approaches.

We need to look at interactive systems and the underlying causes of our 'problem' in addition to investigating diverse and whole system strategies and solutions. The only other path leads us into the stranglehold of the 'technological fix' (Fisher & Macdonald, 2006) of which there are numerous examples in the areas of environment, health and farming also (perhaps in any endeavour dealing with complex and/or biological systems) in which single factor 'solutions' taken out of context simply lead to further problems.

There are many additional advantages that can be gained from sustainable biological and nutrition based approaches to farming that are beyond the scope of this submission but worthy of further investigation. These include improvements in broader environmental outcomes, population nutrition and health.

Climate Change and Agriculture We understand that the effects of climate change are likely to involve greater seasonal variation and unpredictability but probably with decreasing rainfall and overall increasing temperature, evaporation and dryness.

Inevitably estimates vary, but agriculture is responsible for a significant proportion of the world's carbon dioxide, methane and nitrous oxide emissions. These could be as high as 25%, 60% and 80% respectively (NTS, Plant Management, p.7)

Significant amounts of carbon are lost into the atmosphere due to the over-use of carbon free fertilizers, low levels of or damage to microorganisms, over use of herbicides and pesticides and improper tillage and grazing practices.

In addition to the loss of carbon into the atmosphere, of equal concern is the massive release of Nitrous Oxide through agricultural practices. Also a greenhouse gas, Nitrous oxide has a global warming potential (GWP) of 310 times (over one hundred years) that of CO2, and an atmospheric lifetime of 120 years. http://www.cogeneration.net/Global_Warming_Potential.htm .It is estimated that about 12 million tonnes worldwide are released into the atmosphere each year, the chief sources being nitrogen based fertilisers, un-composted human and animal waste, and car exhausts. (NTS, p.4)

'Nitrogen mismanagement not only contributes to nitrous oxide pollution – with 10% of the nitrogen applied in fertilisers, or 7 million tonnes being lost to the atmosphere' in this form – 'it is also responsible for serious CO2 release' 'Nitrogen creates a feeding frenzy amongst bacteria'..., and if carbon is not supplied In adequate amounts 'bacteria have little option but to consume organic carbon to balance their nutrition, releasing CO2 in the process'(NTS, p.7)

Thus proper management of Carbon and Nitrogen becomes a key issue in reducing the negative impacts of farming on climate change, at the same time as making the sector more resilient to climate change impacts.

Farming and Adaptations to Climate Change - Coping Strategies

Farmers can better adapt to climate change through a number of innovative and often relatively simple approaches. We need to catch and hold water better.

<u>Catching precipitation</u>

<u>Storage tanks and dams</u>

Conventional tanks and dams are only useful to the degree that there is still enough precipitation to top them up. The best approach here is to combine them with other techniques of:

reducing dam evaporation by planting well designed and productive shelter belts around dams (Morrow, R., 1997),

reducing water use through reduced soil evaporation and better water holding capacities in soils and better crop choices,

This should help conventional water storage to last longer.

<u>Catching and holding water</u>

<u>Soil Structure, Soil Life, Nutrients and Carbon, and Techniques for Reducing Evaporation</u>

Water holding capacities of soils can be increased through the proper ratio of Calcium to Magnesium. This creates a better soil structure through increased flocculation of soil particles allowing spaces between soil aggregates for increased air, water retention, and 'homes' for abundant beneficial bacteria and other soil life.

The presence of beneficial microorganisms and sufficient carbon can also lead to increases in soil humus content with further benefits in moisture and nutrient retention and availability to plants.

Carbon

We can considerably increase soils capacity to hold and retain moisture through adopting techniques that build soil organic carbon. Soil carbon is important in fertility, productivity, and moisture retention. 'Carbon is the governor of moisture. One part carbon will hold four parts water' (Skow & Walters, 1995, iv) 'Carbon attracts moisture from the air, especially at night. If there is sufficient humidity in the air and enough carbon in the soil, plants can get enough moisture from the air to fix a crop'

With the correct plantings, even of the right types of grasses in an area, and a change in grazing practices so that we no longer see paddocks close to desertification, dusty and eaten down to almost bare soil, 'it is possible to so manage carbon that it will change the climate of an area. (Skow & Walters,1995, p.68)

This (the creation of carbon, compost and ultimately humus) is no doubt one of the keys reasons for the success of alternative practices of farming such as biodynamic and Homa farming, but I believe not only this but more subtle forces may be in operation here too that are worthy of investigation.

Further techniques of increasing soil carbon and decreasing evaporation:
(Most of the following section comes from

http://www.biodynamics-tas.com.au/web/en/biodynamic/Biodynamics/agriculture.html)

Green manuring can be practiced and 'involves...I incorporating any field or forage crop while green, for the purpose of soil improvement.' This will increase soil carbon and be a food source for microorganisms, and will reduce evaporation of water.

"Green Manure Crops
A green manure occupies the land for a portion of the growing season. These cover crops can be used to fill a niche in crop rotations, to improve the conditions of poor soils, or to prepare land for a perennial crop. Legumes such as peas, beans, clovers, or lupins may be grown as green manure crops to add nitrogen along with organic matter. Non-legumes such as oats and barley are grown to provide biomass, smother weeds, and improve soil tilth."

Cover crops can also be grown. These primarily provide soil cover, and can help prevent erosion, loss of water through evaporation, and can help suppress weeds and reduce the need for pesticides and herbicides thus supporting soil carbon building

"**Winter Cover Crops**
A winter cover crop is planted in late summer or autumn to provide soil cover during the winter. Often a legume is chosen for the added benefit of nitrogen fixation. Cool-season legumes include clovers, lupins, medics, faber beans and peas. They are sometimes planted in a mix with winter cereal grains such as oats, barley, or wheat.

Living Mulches
A living mulch is a cover crop that is interplanted with an annual or perennial cash crop. Living mulches suppress weeds, reduce soil erosion, enhance soil fertility, and improve water infiltration. Examples of living mulches in annual cropping systems include no-till planting of seedlings into subclover, clover drilled into small grains, and annual ryegrass broadcast into vegetables. Living mulches in perennial cropping systems are simply the grasses or legumes planted (or self seeded) as ground covers over the beds and in the alleyways between rows to

control erosion and prevent leaching.

Benefits for Organic Matter and Soil Structure
A major benefit obtained from green manures is the addition of organic matter to the soil. During the breakdown of organic matter by micro-organisms, compounds are formed that are resistant to decomposition—such as gums, waxes, and resins. These compounds—and the mycelia, mucus, and slime produced by the micro-organisms—help bind together soil particles as granules, or aggregates. A well-aggregated soil tills easily, is well aerated, and has a high water infiltration rate. Increased levels of organic matter also influence soil humus. Humus—the substance that results as the end product of the decay of plant and animal materials in the soil—provides a wide range of benefits to crop production.

Soil and Water Conservation
When cover crops are planted to prevent leaching, they should provide a high percentage of ground cover as quickly as possible. Most grassy and non-legume cover crops, like oats and barley, fulfil this need well. The soil conservation benefits provided by a cover crop extend beyond protection of bare soil during non-crop periods. The mulch that results from a cover crop in no-till plantings increases water infiltration and reduces water evaporation from the soil surface. Soil cover reduces soil crusting and subsequent surface water runoff during rainy periods.

http://www.biodynamics-tas.com.au/web/en/biodynamic/Biodynamics/agriculture.html

Note: To get carbon in the soil to go down, magnetism must first be created which means phosphate molecules must be utilised in such a way to create conditions supportive of bacteria, which in turn requires aeration of the soil. If air can no longer enter the soil, carbon goes out into the atmosphere as carbon dioxide. (Skow and Walters 1995, p.68) This is significant as 'When 1% of organic matter per hectare is oxidised, due to improper tillage practices and the over-use of carbon-free fertilisers, then 20 tonnes of CO2 per hectare is released.'(NTS, 2008 Plant Management, p.11)

The use of most farm herbicides and pesticides, as well as common tillage practices are in fact part of the problem as they largely destroy beneficial fungi and other microorganisms in our soils. We can thus look after soil health and increase carbon sequestration by dramatically reducing our reliance on pesticides and herbicides. We need to recognise that a significant amount of pest and disease pressure comes from imbalances in nutrition, either through deficiencies or from the overuse of nitrate fertilisers leading to poor cellular structure and increased susceptibility to insect attack.

Because of their 'hotness, the majority of agricultural fertiliser inputs are also highly detrimental to the living carbon stores in our soils, and can quickly destroy the benefits gained. We can reverse this loss by creating the right conditions for the formation of humus with its rich populations of bacteria, fungi and other soil organisms, literally re-embodying the carbon which has been lost.

Adaptation to Climate Change: farming as part of the Solution
Agriculture in Australia is a heavy producer of greenhouse gases and has a 'response ability' and obligation to reduce its emissions.

However the most exciting possibility is that agriculture can contribute to the solution to climate change by becoming a sink for excess carbon in the atmosphere. 'The capacity of soils to keep (or take) carbon out of the atmosphere is 10 times that of vegetation or biomass' (NTS, Plant Management, p.11) It has been suggested that 'if we could increase the organic content of our farmlands by one tenth of one percent every year we could (over time and without increasing emissions from other sources) take all that excess carbon out of the atmosphere and put it back into the soil.' (Sait, 2003) 'It has be estimated that a 1% increase in organic matter in US croplands alone would take 4.5 million tonnes of CO2 from the atmosphere and return it to the soil.' (NTS, Plant Management, p.11) Farmers can thus make a huge contribution to carbon sequestration.

The primary way of making these gains is through the creation of humus.
Humus – 'Humus is a dynamic condition, for it is constantly being formed from plant and animal residues and is continuously being decomposed by micro-organisms. It is colloidal, a dynamic state between liquid and solid. It is characterized by high cation exchange capacity, serves as a source of energy for various groups of micro-organisms, combines with various inorganic soil constituents, absorbs large quantities of water and therefore serves as an important factor in the control of aeration, water holding capacity and granulation of paddock and garden soils. If manure and organic matter are brought to the soil in the form of humus, it will be absorbed immediately and made available for plant and soil life.'
http://www.biodynamics-tas.com.au/web/en/biodynamic/Biodynamics/agriculture.html

Humus is therefore beneficial for drought resistance, pH bufferning, mineral retention and availability, and soil structure and stability. It can hold from '80-90% of its weight in water, and microbes which live in stable humus emit a gum-like mucilage, which also helps to retain moisture in the root zone' (NTS, Microbe Management, p.5)

Farmers can build humus by: including a carbon source with every fertiliser, reducing and/or modifying tillage, nurturing and protecting soil life, and consciously striving to build organic matter levels in the soil (NTS, Plant Management, p. 11)

One of the 'greatest opportunities for inexpensive humus building, is the efficient digestion of crop residues' which requires cellulose digesting fungi to convert these residues into humus. (NTS, Plant Management, p.12)

What can government do to assist?
Helping the shift towards sustainable practices
Promoting research, extension and training

Government can support this necessary transition in agriculture through various strategies including partnerships with farmers for demonstration, education and extension sites and services in all regions and states, Establishing demonstration farms to show how new farming systems can work and to form sites for research and training would be a significant contribution.

Another vital step is through financial support to farmers for making steady improvements in their soil management, farm nutrition, tillage practices, and microbe enhancement. This could occur through the re-imbursement of farmers for steady improvements in soil carbon and humus content.

Carbon trading schemes are not adequate. They are problematic to administer and only allow farmers to benefit from their good efforts at carbon sequestration by selling their carbon credits to polluters, leading to reduced net benefits.

A carbon tax on polluters would be far preferable and would allow the reimbursement of farmers who already have trouble surviving financially. This would also act as an incentive to energy producers and industry to transition to non carbon or low carbon sustainable energy sources. As costs would inevitably be passed on to consumers, it would also encourage consumers to change to sustainable energy sources and consumption patterns.

There is a desperate need for recognition of carbon storage in pasture, soils and on farm trees and crops which is not be recognised under the current plans!
Additional ideas – Urban Planning could allow for sustainable food production in urban areas or in public space at affordable land prices,
Farms could become sites for local production of solar and wind power alternatives
Crop choices such as low water rice varieties and growing methods could also be significant. See Fukuoka. The One Straw Revolution.

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