Biological Farming Systems - CO_2 Sequestration Estimate and N_2O Reduction

Biological Farming Systems (BFS) is a pursuit of agricultural practices that creates soil mineral balance, promotes organic soil carbon and increases healthy soil biota to ensure sustainably productive soils.

Background

Australia's rangelands (tropical savannas, temperate woodlands, shrublands and grasslands used for extensive grazing) are estimated to comprise approximately 288M hectares. The land areas devoted to more intensive agricultural production comprise approximately 167M hectares (National Land and Water Resources Audit). The estimate below uses Australia's cropped area of 24.7M hectares which is dry land and irrigated area.

Cropping is therefore a relative small component of what could be achieved across all agricultural land use. An important example though, as CO_2 emissions in cropping currently is high and increasing because of chemical fertiliser, pesticides/ fungicides and diesel use as traditional solutions to production problems.

CO_2 Sequestration Estimate

Table 1 illustrates the significant quantity of atmospheric CO_2 that can be sequestered per annum (by plant photosynthesis via the plant roots structure and biological/chemical interactions) by a given agricultural area adopting BFS with an absolute soil carbon increase of 0.15%. This increase is conservative and realistically achievable by adopting BFS. BFS field results have shown soil carbon to increase by 1.2% over 3 years, in samples taken from the top 15cm of soil.

Quantity of CO_2 sequestered (t) by a total soil carbon increase of 0.15%, to 0-15cm soil depth and bulk density 1.5g/cm^3 over an area (ha) in one year.

Table 1.

Agricultural area to be treated (ha)	Area as a % of the Total Cropped Area in Australia (dryland & irrigated)	Equivalent CO_2 sequestered (tonnes)	% of Australian annual CO_2 emissions	Value of carbon credits to farmers
1		12.39		
200 000	0.8	2 478 000	0.41	$37.17 M
4 940 000	20	61 206 600	10.2	$918.1 M
12 350 000	50	153 016 500	25.5	$2.3 B

The conservative estimate is that 25% of Australia's annual CO_2 emissions can be sequestered by 50% of Australia's cropping land adopting biological farming systems and increasing soil carbon.

Table 1 Assumptions:

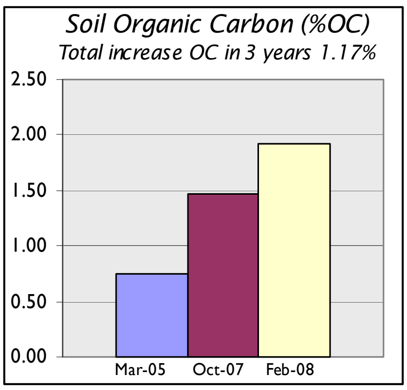
1. Soil carbon content is usually expressed as a concentration (%). To convert from concentration to stock (t/ha) the depth of measurement and soil bulk density parameters are required. Standard soil sampling methods used in agriculture are to a depth of 15cm, however sampling to greater depths is recommended for future assessment. Soil bulk density (g/cm^3) is the dry weight (g) of one cubic centimetre (cm^3) of soil and varies with different soils and depths. Most soils range from 1.0-1.8 g/cm^3. An average bulk density of 1.5 g/cm^3 is assumed for the calculations. The soil carbon stock is determined by multiplying the carbon concentration (%) by the bulk density (BD) by the soil volume in a 15cm profile of a one hectare area.
2. Carbon dioxide equivalent sequestered will be calculated by multiplying the carbon stock by 3.67. Every one tonne increase in soil carbon represents 3.67 tonnes of carbon dioxide sequestered from the atmosphere.
3. Soil carbon increase is a conservative 0.15% per annum. BFS field results have shown soil carbon to increase by 1.2% over 3 years (0.4% per annum), in samples taken from the top 15cm of soil.
4. Australian CO_2 emissions currently total 600M tonnes per annum
5. Carbon credits are valued at $15 per tonne of CO_2 for calculations

Biological Farming Systems Field Example

LawrieCo work with farmers and have established a precedent of outstanding increases in soil fertility with BFS. Currently over 300 farms covering over 300,000 hectares are using BFS which includes BioLogic fertiliser blended from Victorian lignite coal. On farm results indicate a high potential for Australian agriculture to sequester significant atmospheric carbon dioxide and reduce chemical fertiliser use with subsequent reductions in nitrous oxide emissions. Charts showing increased soil carbon and reduced fertiliser use are displayed below.

'Kriegfields' - Broad acre continuous cropping, Mid North South Australia

- Started using BFS in 2005, yields have maintained or improved and reduced pest and disease
- 0.7-1.2% trend increase in soil organic carbon in 3yrs
- Reduced fertiliser use by 70% phosphorus and 85% nitrogen compared to previous use



Fertiliser Use Compared	Phosphorus Units or kg	Nitrogen Units or kg	N_2O Emissions (kg) Over 400Ha	CO_2 Equivalent (kg) Over 400Ha
80-100kg/Ha DAP 6okg/Ha UREA **(2005) Pre BFS TOTALS**	**18**	**44.2**	221	68,510
30-50kg/Ha 15:13:0:9 Growth foliar 2-3 L/Ha (x2 app) **(2008) BFS TOTALS**	**5.4**	**6.25**	31.25	9,687.5
Fertiliser reduction/ Potential Emissions Saved	**12.6/Ha (70%)**	**37.95/Ha (86%)**	**189.75**	**58,822.5**

Assumptions: (Source - Nitrous oxide emissions from cropping systems. 16.01.07 GRDC Research Update)
1. 1.25% of all inorganic nitrogen fertiliser is emitted as N_2O
2. N_2O has 310 times more global warning potential than carbon dioxide