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Land management change may be a viable method of sequestering carbon

Warwick Badgery

A large soil survey that aims to characterise the levels of soil carbon under different land management systems, soil types and climate scenarios is in the final stages of being completed in the Lachlan Catchment. The sampling is being conducted under two projects. The first is Soil Carbon Research Project (SCaRP), which is a national program designed to assess the impacts of changes in agricultural management on soil carbon. The second is the Market Based Instruments for Soil Carbon – achieving soil health targets (CAMBI), which aims to not only characterise soil carbon in a similar way to the SCaRP project, but will use this information to develop a pilot market based instrument where farmers can be paid to store carbon in the soil by changing land management.

The results to date have shown that the greatest difference in soil carbon between sites has been in the top 10cm of the soil. Below this level, the soil characteristics (parent material, texture and depth of A horizon) vastly impact on the ability of the soil to store carbon. While soil characteristics also remain important in the top 10cm, rainfall has had the strongest relationship with carbon and land management has been a secondary factor. To give an indication of the order of magnitude, on chromosols and dermosols located from Boorowa and Young in the east to Temora and Trundle in the west, on average there was a 10 t/ha difference in the amount of carbon stored in the soil between the highest and the lowest land use. The highest land use was undisturbed remnant vegetation with 43.3 t/ha and the lowest was crop in rotation with 33.3 t/ha. Pasture in rotation had levels of 36.3 t/ha and permanent pasture had 38.4 t/ha.



Technical officer Liz Warden characterising soil profile samples as part of the SCaRP and CAMBI sampling

The role of land management such as tillage system, fertiliser use and grazing management is still under investigation. The expected differences in soil carbon are small and whether this is a viable tool for mitigating atmospheric carbon dioxide will depend on the price paid for carbon, the cost of accurately verifying the amount of carbon sequestered and whether there is significant leakage (e.g. from increased methane emissions from livestock if the area of pasture increases).

Soil focus for Northern Rivers Landcare Awards

Simon Proust, NRCMA

Greg & Sally Chappell are worthy winners of the 2011 **Northern Rivers Landcare Producer Award** and run an Angus stud on 1200ha, 10km south east of Glen Innes. Their farm operation includes leased blocks at Ebor and Gunnedah.

'Shannonvale' is an historic Glen Innes farm, for many years producing potatoes, corn, peas and carrots with vegetables supplying the cannery in Glen Innes. Past cultivation had been detrimental to the basalt and granite derived soils. The Chappell's purchased 'Shannonvale' ten years ago after farming on small properties at Moree, Tamworth and Willowtree.

Initially, Greg and Sally applied superphosphate but felt they were in a cycle of high inputs. Five years ago, they trialled manure fertilisers and introduced a wider range of perennial grasses which transformed their soils. The grasses out compete the weeds and hold the soil together - which came in handy last year when the Mann river flooded five times.

The manure, sourced from a feedlot from Moree, proved too bulky – being applied at 3t per ha involved a lot of cartage. They now use the manure together with straw as raw material (with some additives) to make compost on farm - which is applied at 300kg/ha. The results are profound with soil organic carbon doubling to 1.5% in four years and their pH increasing by almost 1 unit, as well as increasing groundcover to 90% and pasture perenniality.

The Chappell's manage most of their cattle on 35 paddocks of varying size. When they arrived the property had only 13 paddocks, the largest being 400ac. The progressive shift towards smaller paddocks is aimed at doubling the current

number. All paddocks have watering points and those fronting the river are excluded as part of the NRCMA Mann River project.



Greg and Sally Chappell, with Marhi Koch (GLENRAC) at Shannonvale, near Glen Innes. Image source: S Proust

Landcare winners were announced in April at a function in Grafton. A new award, the **Soil Health Award** was won by another north coast farming couple, Trevor and Kay Wilson. For a list of all award winners see www.northern.cma.nsw.gov.au

Both farms now go on to represent the Northern Rivers at state level. The Chapells at the state-wide Landcare awards in Parkes in September this year while the Wilsons will participate in the Carbon Cockies competition in Dubbo. Good luck to them both.

Biochar mineral complexes

Abigail Jenkins

Stephen Joseph, chairman of Anthrotterra Pty Ltd and a Professor of Materials Science at UNSW is very passionate about biochar and the seemingly numerous possibilities for its use. Recently Stephen presented some of the interesting and exciting possibilities of this material. Dr Joseph's talk ranged over a whole array of issues and topics associated with biochar with special emphasis given to both its production and a new way of using this product in agriculture by creating biochar mineral complexes (BMC).

BMCs are a mix of biochar, clays and biomass such as animal manures that is baked at a relatively low heat (about 400°C). Dr Joseph has observed that, BMCs have outperformed plain biochar in the field. Under the electron microscope BMCs look a lot like the micro-agglomerates found in the rich Terra Preta soils

in the Brazilian Amazon. The research work carried out by Dr Joseph and his colleagues indicate that BMC's effectiveness is due to

- 1) increases in the concentration of fungi and other beneficial bacteria
- 2) increase in organic molecules that assist in seed germination. Some of these molecules could act as signalling chemicals that increase the concentration of beneficial microbes
- 3) changes in both proton and electron activity that reduces the energy required for plants to take up nutrients
- 4) increase in cation exchange capacity due to the high concentration of oxygenated functional groups on the surface
- 5) Increase in water holding capacity
- 6) Increase in nutrient recycling through adsorption of dead micro-organisms and soil organic matter

Dr Joseph is very keen on producing a product that can be applied in similar volumes to that of conventional fertilisers so we get away from the 10 -20 t/ha biochar application rates usually advocated for plant growth response.

In an era where concerns over food security, climate change and energy shortages are growing, it is exciting to think that we may be able to improve the efficacy of fertiliser while optimising waste reuse and generating power. It is equally amazing to think that we may be able to better harness the biological component of the soil using this material. It is indeed food for thought and potentially more food for all. For more about biochar see:

<http://www.biochar-international.org>

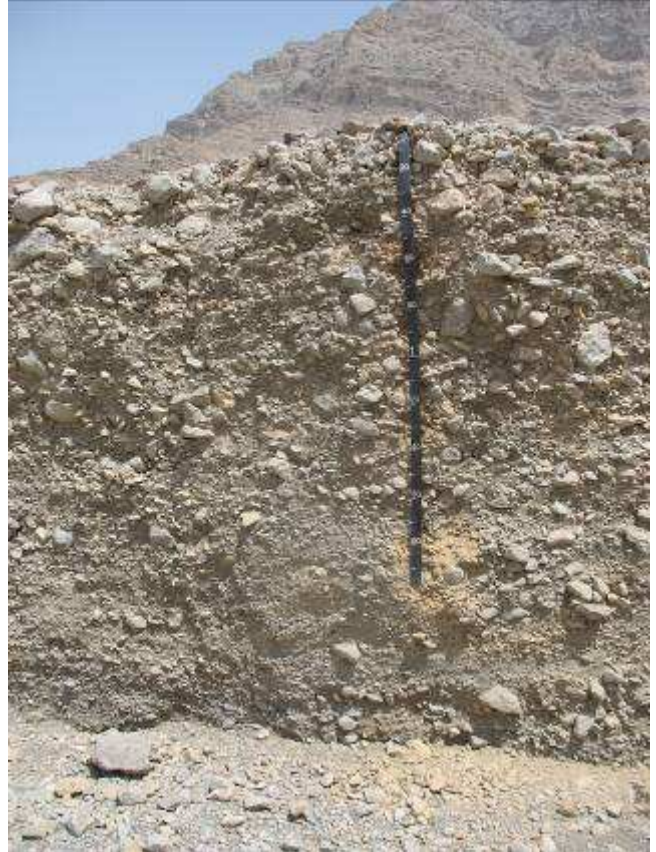
Soil Survey in the Northern Emirates (United Arab Emirates)

Dave Morand

From late February to the end of April 2011 local north coast soil surveyor Dave Morand assisted in managing a mapping project in The United Arab Emirates (UAE), based in the town of Al Dhaid at the offices of the Ministry of Environment and Water, east of Dubai, The project described about 10000 soil profiles and a lot of gravel.

To say that many of the sites Dave investigated were challenging would appear to be an

understatement. Dave said "The profile description mostly dealt with the different rock sizes and their distribution". Dave even had to resort to using a colander for a sieve! The majority of sites were described using a hand auger.



Typical 'soil' profile in mountain wadi. Image source: D Morand

This part of the UAE has a mixed geomorphic pattern. The Hajar Mountains flank the east coast of the UAE, extending into Oman. These mountains consist of ophiolite beds (ie: pieces of oceanic plate that have been thrust onto the edge of continental plates). Oman and the UAE are geologically renowned for hosting the largest, best-exposed, least deformed and most studied fragments of oceanic lithosphere preserved on land. On the western side of these mountains extensive gravel plains and fans merge into the sand dune country that extends to the Persian Gulf. Prominent wadis (valleys) have incised the mountains. Many of these wadis are filled with compact quaternary gravels which of course makes looking at the soil in profile a challenge. At these sites observations were restricted to available exposures.

The Soil distribution can be divided into 4 broad types of occurrence:

1. Dunes - sands.
2. Gravel plains and fans - sandy soils with considerable amounts of gravels; carbonate and gypsum concentrations often present.
3. Mountain wadis - extensive gravels often cemented by carbonate; generally <10% sandy soil material.
4. Coastal plains and flats - wet sandy soils with high salt content.



Geoprobe used for some soil sampling. Image source: D Morand

The mapping, which will be used to aid broad-scale land use and agricultural expansion, was undertaken by the Australian company GRM International on behalf of the Abu Dhabi Environment Agency. Scale of mapping is 1:50000. Total area mapped is about 5000 km² excluding mountain and city areas.

Learning about livestock methane – ‘Trevenna’ Armidale

Clare Edwards, District Agronomist Armidale, DPI NSW.

Part One – the Demonstration

A 36 ha demonstration site at the University of New England’s ‘Trevenna’ property, on the Northern Tablelands is investigating two management systems on crossbred lamb production, giving producers and researchers a practical insight into the carbon cycle, in particular methane. While research is focusing on the amount of methane per live weight gain, the demonstration site is looking at the whole system: soils, pastures, livestock, and the production cycle.

Trevenna has a summer dominant rainfall and varies in elevation from 1068m to 1022m. The site has two different landscapes: hill country dominated by summer growing natives,

interspersed with yearlong natives and naturalised cool season introduced species. The flats are dominated by perennial introduced species with a large percentage of legumes.

An initial EM38 survey and soil samples stratified the landscapes and paddocks for the demonstration. Additional subdivision occurred to block each landscape into three classes and three paddocks within each class. Fertiliser has been applied to delineate the differences between the 2 landscapes.

Monthly pasture (green herbage mass, legume percentage and quality) and regular animal production data (live weight, condition score, fecundity, wool and carcass weights at slaughter) are being collected. Seasonal botanical composition is examined within the two landscapes. Monthly pasture scans of the paddocks are made by the Crop Circle (Holland Scientific equipment model ACS210) and correlated with measured herbage mass. Water holding capacity and nitrous oxide are recorded. Recently, soil carbon, soil bulk density and annual monitoring of soil fertility measurements have been taken.

Stocking densities were determined using PRO Plus™. Fodder budgets indicated a stocking rate of 3.7 DSE/ha on the hills and 6.7 DSE/ha on the flats. Allocation of the pregnant Merino ewes was randomised and lambing occurred in September 2010.

Data collected will improve our understanding of whole-farm sheep production systems on the Northern Tablelands. Information will be used in models such as AusFarm and SGS, and the inventory models such as FarmGas and OVERSEER. In 2012, a detailed analysis will examine the differences between the two landscapes. A lifecycle analysis and economic study will be conducted at the end of the project.

One of four sites across Australia established in collaboration with Meat and Livestock Australia and the Australian Government’s Climate Change Research Program to demonstrate potential mitigation strategies for enteric emissions, it is a joint project between NSW Department of Primary Industries and the University of New England. For further information on the project contact Dr Malcolm McPhee, NSW DPI 6770 1838.

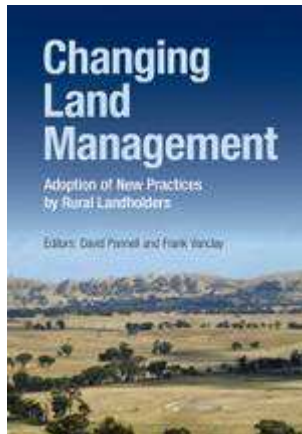
Part Two in the next edition of All the Dirt will cover information on the soils and their parameters on the Trevenna demonstration site.

New Publications

Changing land management: adoption of new practices by rural landholders

Pannell D and Vanclay F

CSIRO advertises this new book by well respected authors as providing "key insights from past and cutting-edge research to support decision-makers as they attempt to influence or assist rural communities adapting to changed circumstances.



<http://www.publish.csiro.au/pid/6483.htm>

Evaluation of tolerable erosion rates and time to critical topsoil loss in Australia

Elisabeth Bui, Gary Hancock, Adrian Chappell and Linda Gregory

The CSIRO Sustainable Agriculture flagship has released a report identifying regions at risk of exceeding 'tolerable' rates of soil loss. The report calculates the amount of time land managers have to arrest soil erosion and establish a sustainable soil resource that balances erosion, deposition, and soil formation rates.

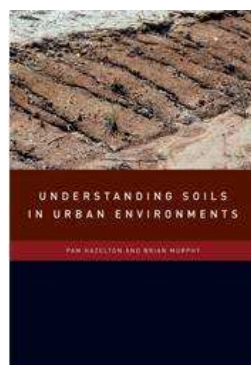
www.nrm.gov.au/publications/books/pubs/tolerable-erosion.pdf



Understanding soils in urban environments

Pam Hazelton & Brain Murphy

This book explains what urban soils are, how they change, develop and erode. The chemical and physical properties are explained. The book focuses on specific soils in urban settings such as acid sulphate soils which can cause a range of environmental issues in



urban areas. It also addresses the contemporary convergence of soils and the urban environment such as green roofs, urban green space and man made urban soils for good plant growth. It is available from CSIRO.

www.publish.csiro.au/nid/18/pid/6420.htm

To live within the Earth's limits: An Australia plan to develop a science of the whole earth system

Gifford, RM, Steffen w and Finnigan JJ

There is a growing recognition that the current issues facing all the environments in which we live face challenges that require a different and more integrated approach than has existed previously. It argues that an 'integrative science of the earth system' is needed to understand the complexity.

The publication describes its aim as setting out 'a systematic and coherent plan to create a scientific enterprise – combining inputs from the natural and social sciences, economics and the humanities- which is devoted to understanding the planets life support systems.'

It is available on-line at www.science.org.au/natcoms/nc-ess.html



Australia Carbon Farming Initiative

An article outlining the implications of the Carbon Farming Initiative for Australian agriculture, including offset methodologies, the role for trees and for soil carbon, and integrity standards such as permanence and additionality appears on the CSIRO's ECOS website.

<http://www.ecosmagazine.com/paper/EC10100.htm>

Protecting Queensland's strategic cropping lands: proposed criteria for identifying strategic cropping land

The Queensland government has proposed new legislation aimed at protecting land deemed to be strategic cropping land, specifically those cropping areas in Central and Southern

Queensland. Specific criteria, much of which is soil based, will be used to draft the strategic cropping lands legislation.

The criteria were released on 14 April 2011, along with a technical report and independent expert review, to view the document see <http://www.derm.qld.gov.au/land/planning/pdf/strategic-cropping/proposed-criteria.pdf>

For more information on policy and legislation see

<http://www.derm.qld.gov.au/land/planning/strategic-cropping/index.html>

Black gold: from waste to wealth

Far from exhausting the land, jungle farmers can create the most fertile soils read the article in the New Scientist, volume 210 issue 2815.

<http://www.sciencedirect.com/science/article/pii/S0262407911613286>

City to Soil

The City to soil program, which aims to encourage composting of urban green waste and delivery to agricultural land council waste, is building momentum.

For more information read the ECOS article, the mid-project report, and the blog which has a range of information sheets.

ECOS article:

<http://www.ecosmagazine.com/paper/EC10093.htm>

Blog:

<http://www.groundswellproject.blogspot.com/>

Report:

<http://www.scribd.com/doc/48464848/Groundswell-Agronomy-mid-project-report>

Web resources and tools

Soil carbon and nitrogen

Victoria DPI has developed animated explanations of the soil carbon and nitrogen cycles, providing accurate, yet simple depictions of these complex cycles as they relate to soils and agriculture.

http://www.dpi.vic.gov.au/dpi/vro/vrosite.nsf/page/s/soilhealth_organic_carbon-cycle

Soils: the roots of life

For all lovers of soils and their beauty check out the images at

<http://web.me.com/jrichardson4754/Albums/Environment/Pages/Soils.html>

Soils Glossary

<https://www.soils.org/publications/soils-glossary>

Saving acid wetlands

The recent catalyst story about Trinity inlet acid wetlands can be viewed at

<http://www.abc.net.au/catalyst/stories/3221659.htm>

Making better fertiliser decisions

A new database to help cropping farmers make better fertiliser decisions is being set up by NSW DPI. The National database of over 400 fertiliser trials is being set up under the "Making better fertiliser decisions for cropping systems in Australia" project supported by the GRDC.

For more information see

www.dpi.nsw.gov.au/info/bfdc

Research papers

European Journal of soil science

The European Journal of Soil Science has 2 recent special editions to look out for if you are interested in pedometrics (Vol. 62 No. 4) and or soil organic matter (Vol.62 No 1).

[http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1365-2389](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1365-2389)

Biochar Incorporation into Pasture Soil Suppresses in situ Nitrous Oxide Emissions from Ruminant Urine Patches

Arezoo Taghizadeh-Toosi, Tim J. Clough, Leo M. Condron, Robert R. Sherlock, Craig R. Anderson, Robin A. Craigie.

Journal of Environment Quality, 2011; 40 (2): 468

<http://www.sciencedaily.com/releases/2011/03/110318102245.htm>

Manure management in no till cropping systems

Journal of environmental quality special edition

<https://www.agronomy.org/publications/jeq/tocs/40/2>

"To forget how to tend the soil is to forget ourselves"

Mahatma Gandhi

Events

Conference: Grassland farming – Opportunities, threats and realities

26th to 28th July, 2011

Bathurst Memorial Entertainment Centre

The Grassland Society of NSW holds an annual conference each year.

http://grasslandnsw.com.au/blog/?page_id=3

Conference: 3rd National ASS

March 1-7 2012

Novotel on Collins Melbourne, Victoria

Sponsored by Southern Cross Geoscience the theme for the 3rd ASS national conference is common ground; shared experience: practical solutions. For more information www.scu.edu.au/nationalassconference

Conference: 2nd Asia Pacific Biochar Conference

September 2011.

Kyoto

Hosted by the Japan Biochar Association (JBA), Japan Association for Human and Environmental Symbiosis, and Ritsumeikan University, in affiliation with: Australian New Zealand Biochar Researchers Network (ANZBRN) and International Biochar Initiative.

<http://apbc2011.com/>

Conference: 5th ASSSI / NZSSS conference: Soil solutions for diverse landscapes

2 – 7 December 2012

Hobart; Wrest point convention centre

For more information see:

<http://www.cdesign.com.au/soilscience2012/>

Course: Soil Food Web courses

22nd August – 2nd September 2011

Southern Cross University, Lismore, NSW,

Cost: \$2,680.00, student discount price: \$1,680.00 (all process GST Incl)

Two week accredited course (+ 1 week home readings) for more information visit

www.soilfoodweb.com.au

Workshops: Get your business carbon ready

July 2011

North coast TAFE campuses

The north coast Institute of TAFE have been running a number of 2 day free workshops on carbon accounting. The Lismore and Coffs Harbour workshops are due to take place in July for more info contact Robyn Apolony at Business Services p: 02 6591 3686

e: robyn.apolony@tafensw.edu.au

Workshop: Planning for A Sustainable Energy Efficient Farm - Certificate IV.

Saturday Aug 20 (then 4 following Saturdays)

Coffs Harbour TAFE Education campus.

For more information phone 66593000 or

lan.Hazell@tafensw.edu.au

Field day: Conservation farming Field Days

July 5 or 6, 9:30am – 3pm

Casino RSM

Register early at NRCMA Alstonville office: 66270170/118. Lunch is included Funded by Caring for our Country and NRCMA

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Industry & Investment

Carbon Farming Week 2011

preparing farmers to trade

DUBBO 27-29 SEPTEMBER

EARLY BIRD SPECIAL

Register
Online
TODAY
& SAVE!



Incorporating:

Festival of Fertilizer

*Compost, Bioferts,
Creating healthy soil*

Carbon Farming 101

*Farm ready
approved*

Carbon Farming Conference

Carbon Farming Expo

Carbon Cocky Awards Gala Dinner

www.carbonfarmingconference.com.au